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ABSTRACT

A pilot project was undertaken in 1984 at the Mauritius Institute of Education for the purpose of developing and preparing teaching/learning materials for out-of-school Science and Technology Education programs. This volume is one in a series of UNESCO programs which encourage an international exchange of ideas and information on science and technology education. This specific study is based on experimental work related to technical design, nutrition, and agriculture. Though prepared in Mauritius, the materials offer scope for adaptation or adoption elsewhere. This guide contains three major units of work which focus on: (1) the bagasse burner; (2) food preservation; and (3) kitchen gardening. Each unit consists of a list of aims and objectives, needed materials, background information, and activities. A general overview of the project is provided in which broad objectives, a timeline, and project materials and experiences are explained. (ML)

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Practical Activities for Out-of-School Science and Technology Education

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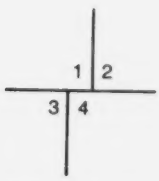

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Science and Technology Education

Document Series No. 17

Practical Activities for Out-of-School Science and Technology Education

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UNESCO

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Preface

The document series was initiated as part of Unesco's Programme on Teaching of Science and Technology to encourage an international exchange of ideas and information on science and technology education. This is further intended to develop greater awareness and better understanding of the nature of science and technology and their role in a changing society by improving and extending their teaching to in and out-of-school education.

The present volume deals with some selected practical activities emphasizing the applications of science and technology in daily life. The study is based on the experimental work related to technical design, nutrition and agriculture. Though prepared in Mauritius, the materials offer scope for adaptation or adoption elsewhere. They are directed mainly to young people, teachers and those concerned with informal and out-of-school science and technology education.

The materials were developed under the leadership of Dr. Venkatasamy, assisted by Miss M. Vas, Mr. A. Appadoo and Mr. B. Pully, all of the Mauritius Institute of Education under contract with Unesco. The views and opinions expressed in the study are those of the authors and not necessarily those of Unesco.

INTRODUCTION

In September 1984 with the financial assistance of UNESCO, Paris a pilot project was initiated at the Mauritius Institute of Education with the specific purpose of developing and preparing teaching-learning materials for out-of-school Science and Technology Education for young people. Three units of work were prepared in this connection, thus:

(1) Bagasse Burner
(2) Food Preservation
(3) Kitchen Gardening

The following paragraphs provide a synopsis of the project's objectives, recall the various phases under which the project was undertaken and give an indication of its experiences. Succeeding sections of this document include:

(i) Three units of work prepared by separate teams on the themes mentioned above.

(ii) An annexure which documents project participation.

A. Objectives

The broad objectives of the Project are summarized below:

- to provide out-of-school youth with the necessary know-how for the application of Science and Technology to daily life.
- to encourage the efficient use of locally available raw materials or indigenous resources.
- to develop an ability to think about and utilize appropriate technology.
- to develop an appreciation of work as good in itself and as a means of living.
- to develop self-sufficiency, self-reliance and creativity

B. Project Activities

The work was carried out in five main phases:

Phase 1

As they began work during the second half of September, Project Staff had two main purposes: to decide about what kinds of relevant and practical activities in the field of Science and Technology should be made available to out-of-school youth, and to identify groups of young people who would be interested participants in subsequent activities. A number of discussions were held both on and off campus: Project Staff, Youth Organizations and so on. After considerable deliberation, three main topics were selected as potentially promising and three task forces were established to examine the following theses:

(a) Bagasse Burner
(b) Food Preservation
(c) Kitchen Gardening

Phase 2

This phase which lasted from mid-October 1984 to mid-February 1985 was concerned with the formulation of instructional objectives and selection of content for the three selected units of work. A student's manual on instruction materials was prepared comprising the "how-to-do or demonstrate" aspect of information.

Phase 3

Following the preparation of materials, training workshops/seminars were organised during the second half of February for the participants who were selected to pilot test the teaching-learning materials. The participants comprised mainly members of Youth Clubs, the National Federation of Young Farmers and "Ecoles Ménagères". The participants examined the appropriateness of instructional materials developed under Phase 2 and considered ways of effectively using the said materials. They identified available resources in the local communities which can be used as support materials.

Phase 4

This phase (March to April) was concerned with the pilot testing and other activities to enhance the learning process. The latter included demonstrations to show the practical applications of scientific and technological concepts and visits to trainees on their site.

Phase 5

This involved the preparation of the final draft of materials to be submitted to UNESCO and occurred during May. Some modifications were brought to the trial materials in the light of feedback obtained during the experimentation.

C. Outline of the Project's Teaching-learning Materials

Three main themes were selected, each constituting a sub-unit in the structure of the materials. They are summarized below:

(i) Bagasse-burner, a fuel-saving cooking device

The specific aim of this unit is to design and construct a low cost cooking device which will use bagasse efficiently as a fuel. The rising cost of electricity and imported fuel coupled with the shortage of wood is making it increasingly difficult for people to find an alternative and appropriate source of fuel. The kerosene cookers commonly referred to as "lampe verte" in the Mauritian context have been found to be unsafe equipment when not properly handled. This points to the need to look for alternative types of cookers. Mauritius, a sugar-producing country, has an abundant supply of bagasse (a by-product of sugar-cane) which can be used fully and economically in the home kitchen.

The unit considers the locally available raw materials which can be used as cheap fuel in the home kitchen (viz. bagasse, saw dust, wood chips), the preparation

of surfaces and the use and care of the various marking out and measuring tools, bench work, the joining of materials, the types of sheet metals appropriate for use, the drawing and design of the cooking device and basic qualifications of weights, areas and volumes, properties, calorific value and specific heat.

(ii) Food Preservation

This unit was designed to stress the importance of taking food at its point of maximum palatability and nutritive value, and of preserving food when they are in season.

It is known that some food can go bad in tropical atmospheres. Moreover, Mauritius being subject to cyclones at certain periods of the year, there is a felt need to preserve certain foodstuffs for such periods.

The unit considers the various methods of keeping food in good condition, the general principles for preserving food, and the different method of preservation. The latter comprises methods which kill micro-organisms (viz. heat sterilization and pasteurisation) and methods which stop the activity of micro-organisms (viz. drying, freezing, preserving agents).

(iii) Kitchen-gardening the organic way

This unit is an attempt at sensitizing young people to use the available land around the family compound to produce vegetables, greens, pulses, fruits and condiments. The stress is on self-sufficiency, self-reliance, on the improvement of the family diet and kitchen-gardening the organic way.

The unit is concerned with the types of food that can be produced and with the cultural practices comprising fencing, soil and seed-bed preparation, sowing, transplanting, watering, mulching, control of pests and diseases, and the use of equipment and tools.

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D. Experiences of the Project

On the whole, the reaction of the participants to the Project materials was a favourable one. The participants showed a positive attitude to the instructional materials. Much interest was shown in the Project and this augured well for future developments in this area.

Attendance at workshops was very satisfactory on the whole; participation rate fell in the case of one group only. Workshop sessions were held longer than expected in certain cases as a result of the keen and active participation of the members.

The Project realises that there are certain constraints in the implementation of the instructional materials. For instance, some of the youth organizations do not possess even nominal workshop facilities and equipment. Thus to demonstrate the construction of the bagasse burner, the trainers had to depend and draw heavily on the resources of the Project. Similarly, it was realized that the participants had to be supplied with planting materials for starting their kitchen garden and with various food items for the trialling of recipes in connection with the theme. 'Food Preservation'.

The time factor proved to be a serious implementation problem, particularly in the establishment of a kitchen garden, since crops take time to grow and follow-up is difficult. The rainy periods at the time of implementation also inhibited early start by the participants involved in the kitchen-garden project.

Moreover, the Project had to work within the constraints of a tight time schedule, and under these circumstances, it was not possible to complete the evaluation of the instructional materials. The Project Staff also faced some difficulty in supervising the work of the pilot group in view of their regular work commitment.

Although most of the participants had the required literacy and numeracy skills and other skills for understanding the instructional materials, it was observed that some of the participants found it difficult to understand concepts such as the SI Units of measurements.

The reorientation courses or workshops proved to be very useful in clarifying concepts and in developing the right attitudes. Thus participants who were in the habit of using fertilizers or inorganic chemicals in gardening, have come by and large to understand the principle of kitchen gardening the organic way. Resistance to chance can be offset by awareness campaigns such as those carried out during workshop sessions. Exposure to the Project's ideas through workshops did help the participants to implement the instructional materials more appropriately.

E. Conclusions

The pilot project has served many purposes though thorough evaluation on the effectiveness of the three units of work is yet to be completed. It has encouraged the project teams to find ways and means to bring the teaching of Science and Technology closer to the life and environment of the learners. The stress has not just been on "educating" the young people involved but on making them understand the importance of problem-solving and their involvement in design processes. The Project has increased the capability of specific groups of young people for solving practical problems through technological means (e.g. materials, tools, source of fuel etc...)

The Project concluded that the preparation of instructional materials on practical activities for out-of-school Science and Technology Education is indeed a significant development. It makes the following recommendations based on this conclusion:

(i) Communication between educators and youth organizations on the matter should continue.

(ii) A mechanism should be considered for the exchange of knowledge, skills and services between these two sectors for their mutual benefit.

(iii) Planning for practical activities in out-of-school Science and Technology Education must be a common responsibility of all concerned, including those in the non-formal sector of education.

(iv) The formal and the non-formal system of education must blend and complement each other in the pursuit of out-of-school Science and Technology Education.

(v) Sharing of experiences in this field among countries must be encouraged in the spirit of international co-operation.

Dr D Venkatasamy

THE DESIGN AND CONSTRUCTION OF A FUEL-SAVING COOKING DEVICE

General Objectives

(1) To design and make a type of cooker that will use bagasse or wood pulp etc.

(2) To know how to use the above cooker efficiently and safely.

INSTRUCTIONAL OBJECTIVES

A Mathematics Component

At the end of the unit the trainee will have

1 knowledge of metric measures of length, mass and capacity.

2 knowledge of simple mensuration formulae for the rectangle, the circle, the cylinder.

3 knowledge of the meaning of density.

4 ability to perform simple calculations involving metric measures of length, mass and capacity.

B Energy and Heat

At the end of this unit the trainee should be able to

1 know different forms of energy.

2 know that energy can be converted from any form to heat energy.

3 know how to use heat energy efficiently.

4 know the meaning of calorific value and to know that different combustible materials have different calorific values.

C Design, Drawing and Development

At the end of the unit the trainee should be able to

1 know the procedure for finding a solution to a design problem.

2 draw object in (a) Orthographic
(b) Isometric projection.

3 draw development of simple 3D objects.

4 read and interpret basic working drawings.

D Workshop Practice and Technology

At the end of this unit the trainee should be able to

1 know the names of the different marking out and measuring tools.

2 know how to use the above tools.

3 take good care of and maintain the above tools.

4 know the names of some common bench tools, e.g. hacksaw, hammer, chisels, files, shears.

5 use and maintain the tools mentioned at D (4).

6 know the different methods of joining and fixing materials together, viz. brazing, welding and riveting, nuts and bolts.

7 use appropriate techniques of joining materials together.

8 know the characteristics of common metals e.g. mild steel, galvanized steel, aluminium copper and its alloys.

9 form sheet metals into required shapes - cutting and bending.

Introduction

With the rising cost of electricity, imported fuel, (e.g. gas and oil) and the shortage of wood, people are finding it difficult to obtain an alternative and appropriate source of energy for cooking purposes.

Many people are using the kerosene cookers commonly known as the 'Lampe verte' which are relatively cheap compared to other types of cookers found on the market. Many cases of accidents have been reported in the use of the 'Lampe verte' and its importation has been prohibited. Accordingly, people in the near future will have to find a substitute to these kerosene cookers. They can at present only switch on to other existing types of cookers or traditional stoves using the locally available firewood and charcoal.

The types of energy used by the above mentioned cookers or stoves are expensive. Oil and gas are imported and electricity is generated mostly from oil. Firewood and its derivatives are becoming more and more scarce as Government policy these days is to preserve and protect the existing forest.

A form of energy that has not been fully exploited on a domestic basis or scale is the abundant supply of sugarcane pulp (bagasse). Bagasse is used industrially to fire boilers in the sugarcane factories and also on a small scale to produce the electrical energy that is required to power these factories. Some bagasse is used to produce boards. At present bagasse is also being pressed into pellets which will eventually be used with coal to power electrical generating stations.

Inspite of the above use of bagasse there is still an abundant surplus which is being dumped. Only a few people living near sugar factories are at present using bagasse for cooking purposes. Therefore the aim of this unit is to popularise the idea of using bagasse as a fuel and accordingly to design and make a cooker that will put the idea of using it efficiently in practice.

A The Metric System of Measurement

1 Measurement of length

(a) The main unit used to measure length is the metre, denoted by the small letter m.

Other units based on the metre are also used, depending upon the size of the object being measured. These other units are related to the metre, as follows:

Name	Notation	Relation to the metre	
kilometre	km	1 000 m	multiples of m
hectometre	hm	100 m	
decametre	dam	10 m	
metre	m		
decimetre	dm	0.1 m = $\frac{1}{10}$ m	sub-multiples of m
centimetre	cm	0.01 m = $\frac{1}{100}$ m	
millimetre	mm	0.001m = $\frac{1}{1000}$ m	

Note: (i) All letters used in the column 'notation' are small letters.

(ii) There is a unit smaller than the mm, called the micrometre and equivalent to $\frac{1}{1000}$ of a mm. This unit is not in everyday use.

(b) We can use the table on page 3 to convert one unit into a smaller or a bigger unit. For example

1 km = 10 hm = 100 dam

1 cm = 0.1 dm or = $\frac{1}{10}$ dm

1 cm = 0.01 m = $\frac{1}{100}$ m

A practical way of converting from one unit to another is illustrated below.

Example 1

Convert 354 mm into cm.

m	dm	cm	mm
	3	5 .	4

354 mm = 35.4 cm.

A decimal point is placed after '5' which is in the cm column.

Example 2

Convert 76 321 mm into m.

km	hm	dam	m	dm	cm	mm
		7	6 .	3	2	1

76 321 mm = 76.321 m.

A decimal point is placed after 6 which is in the metre column.

Example 3

Convert 652 dam into cm.

km	hm	dam	m	dm	cm
6	5	2	0	0	0

652 dam = 652 000 cm.

Zeros are placed till the cm column is reached.

Example 4

Convert 58.2 m into mm.

km	hm	dam	m	dm	cm	mm
		5	8	2	0	0

Zeros are placed till the mm column is reached.

2 Measurement of weight

(a) The weight of an object is a measure of the quantity of matter or substance which it contains.

The central unit of weight is the gramme (g) weight.

As for the measure of length, there are multiples and submultiples of the gramme, as shown below.

Name	Notation	Relation to the g	
kilogramme	kg	1000 g	multiples of the gramme
hectogramme	hg	100 g	
decagramme	dag	10 g	
gramme	g		
decigramme	dg	0.1 g = $\frac{1}{10}$ g	submultiples of the gramme
centigramme	cg	0.01 g = $\frac{1}{100}$ g	
milligramme	mg	0.001g = $\frac{1}{1000}$ g	

Note: (i) All the notations are in small letters.

(ii) A useful multiple of the kg is the metric tonne: 1 metric tonne ≡ 1000 kg.

(b) Conversion from one unit to a higher or a lower unit is performed in the same way as for measures of length.

Example 1

Convert 3725 g into kg.

Knowing that 1 kg = 1000 g, we devide 3725 g by 1000 and obtain 3.725 kg.

A practical way of doing the conversion is as follows:

kg	hg	dag	g
3.	7	2	5

A decimal point is placed after the 3, which is in the kg column.

Example 2

Convert 2.03 g into mg.

Since 1 g = 1000 mg, 2.03 g = 2.03 x 1000 mg

= 2030 mg.

Practical method:

kg	hg	dag	g	dg	cg	mg
			2	0	3	0

3 Measurement of capacity

(a) The amount of liquid which a container can hold is called the capacity of the container.

The central unit of capacity is the litre, denoted by the small letter ℓ .

As for the measures of length and mass, there are multiples and submultiples of the litre. These are indicated in the table.

Name	Notation	Relation to ℓ	
kilolitre	kℓ	1000ℓ	multiples of the litre
hectolitre	hℓ	100ℓ	
decalitre	daℓ	10ℓ	
litre	ℓ		
decilitre	dℓ	$0.1\ell = \frac{1}{10}\ell$	sub-multiples of the litre
centiiitre	cℓ	$0.01\ell = \frac{1}{100}\ell$	
millilitre	mℓ	$0.001 = \frac{1}{1000}\ell$	

The kilolitre is not in everyday use, but the hectolitre, the litre, the centilitre and the millilitre are widely used.

(b) The litre is equivalent to the volume of a cube of edge 1 dm.

Now, 1 dm = 10 cm, so that

$1\ dm^3 = (10 \times 10 \times 10)\ cm^3$

$= 1000\ cm^3$

But 1 l = 1000 ml, therefore 1000 ml = $1000\ cm^3$, giving $\underline{1\ ml = 1\ cm^3}$.

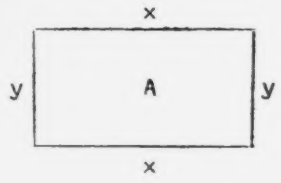
(c) Conversion from one unit to a multiple or a submultiple unit is carried out in the same way as for the two measures described above.

4 Mensuration formulae

(a) The rectangle

(i) The perimeter of a rectangle is the sum of its four sides.

If p = perimeter and x and y the lengths of the sides (see diagram),



$p = x + y + x + y$

$= 2x + 2y$

$= 2(x + y)$.

Example 1

$x = 2.3$ m, $y = 1.8$m, $p = 2(2.3 + 1.8)$m

$= 2 \times 4.1$ m

$= \underline{8.2\text{m}}$.

(ii) The formula for the area A of the rectangle is given by $A = xy$.

Example 2

For the rectangle in example 1 above, the area

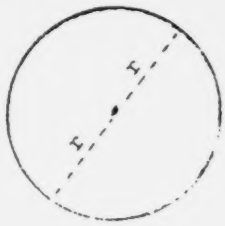
$A = 2.3 \times 1.8\ m^2$

$= \underline{4.14 m^2}$.

(b) The circle

(i) The circumference

The perimeter of a circle is called its circumference.



It is known that the circumference (C) of any circle is approximately three times its diameter (D), that is, $C = 3D$.

Usually the formula is written

$C = \pi D$ or $C = 2\pi r$

where r = radius of circle

$= \frac{1}{2} D$

and π (pronounced like 'pie') is a greek letter which may be taken to have value 3 (very roughly) or more accurately

$3\frac{1}{7}$ or 3.14.

Example: The circumference of a circle of radius 10 cm is very roughly 2 x 3 x 10 cm i.e. 60 cm.

If we want to be more accurate we use the formula $C = 2 \times 3.14 \times r = \underline{62.8}$ cm.

(ii) The disc

The whole region comprising the boundary and the interior of a circle is called a disc.

The formula for the area of a disc is $A = \pi r^2$ where π may be taken to be 3 if we want a very rough approximation, or 3.14 or $3\frac{1}{7}$ if we want to be more precise.

Example: The area of a disc of radius 10 cm is given by

$A = (3.14 \times 10^2)$ cm^2

$= (3.14 \times 100)$ cm^2

$= \underline{314}$ cm^2.

(c) The cylinger

The cylinder is a solid shape with a uniform circular cross section. A cigarette is an example of a cylinder.

(i) Curved-surface area

The formula for the curved surface (A) of a cylinder is given by

A = (circumference of cross-section) x (height)

i.e. $A = 2\pi rh$.

(ii) Total surface area

The total surface of a solid cylinder is made up of the curved part and the two circular ends.

So, the total surface area, A, is given by

$$A = 2\pi rh + \pi r^2 + \pi r^2$$

$$= 2\pi rh + 2\pi r^2$$

$$= 2\pi r (h + r).$$

If the cylinder is open at one end, (e.g. an open tin of peas), the external total surface area is

$$2\pi rh + r^2$$

or $\pi r(2h + r)$.

(iii) The volume of a cylinder

The volume, V, of a solid cylinder of radius r and height h is given by

V = area of cross-section x height

$= \pi r^2 \times h$

$= \pi r^2 h$.

The same formula will give the capacity of a cylindrical container with internal radius r and internal height h.

Example 1

Find the total surface area and the volume of a solid cylinder of radius 10 cm and height 5 cm.

Total surface area $= 2\pi r(r + h)$

$= 2 \times 3.14 \times 10\ (10 + 5)\ cm^2$

$= 62.8 \times 15\ cm^2$

$= \underline{942\ cm^2}$.

Volume of cylinder $= \pi r^2 h$

$= 3.14 \times 10^2 \times 5\ cm^3$

$= 314 \times 5\ cm^3$

$= \underline{1\ 570\ cm^3}$.

Example 2

A cylindrical container has internal height 20 cm and a circular cross-section of radius 10 cm. Find its capacity in litres.

Capacity $= \pi r^2 h$

$= (3.14 \times 10^2 \times 20)\ cm^3$

$= (3.14 \times 100 \times 20)\ cm^3$

$= (3.14 \times 2 \times 1000)\ cm^3$

$= 3.14 \times 2\ell$, since 1 litre $= 1000\ cm^3$

$= \underline{6.28\ell}$.

5 Density

(i) The density of a substance is the amount of matter (mass) contained in a unit volume of the substance.

The density of water is 1 g per cm^3: this means that 1 cm^3 of water weighs 1 gramme.

Example 1

Find the weight of 5l of water.

1l = 1000 cm^3

$\therefore$ 5l = 5000 cm^3

Now, 1 cm^3 of water weighs 1 gm

$\therefore$ 5000 cm^3 of water weigh 5000 g

= 5 kg.

(ii) If we are given the mass(m) and volume (V) of a substance, we can find its density (d) by the formula

$$d = \frac{m}{V}.$$

This formula can be used to find m or V, given the other two quantities.

Example 2

What is the density of copper, given that 60 cm^3 of the metal weighs 540 g.

density = $\frac{m}{V}$

= $\frac{540}{60}$ g per cm^3

= 9 g/cm^3.

Example 3

Given that the density of a metal is 13.5 g/cm^3, what is the mass of 1 m^3 of the metal?

Answer (i) in kg (ii) in tonne.

Volume = 1 m^3 = 100^3 cm^3 = 1 000 000 cm^3

Mass = density x volume

= 13.5 x 1 000 000 g

= 13.5 x 1 000 kg, 1 kg = 1000 g

(i) = 13 500 kg.

(ii) = 13.5 tonne.

B HEAT AND ENERGY

Introduction

A knowledge of energy and of its various forms as well as its efficient use is important in understanding technology.

Many have argued that today's main source of energy - oil, is running out and that we are facing an 'energy crisis'. What are the alternative sources of energy that can be tapped?

There is a close relationship between man's development and his ability to use energy.

Today we are dependent on energy so much so that it would be very difficult for us to survive without it. We need energy to operate machineries in factories, to grow crops, to cook our food, communicate, travel etc.

Long ago man's only source of energy was the food he ate. He was able to convert this energy through his muscles and this helped him to hunt, make simple tools etc. Later he learned to harness the energy of animals, e.g. the ox and horse to help him do more work, such as ploughing the field.

The discovery, and taming of fire helped him to keep warm and cook his food.

Later on when agriculture was fairly developed he realised that other sources of energy existed and he went about to develop them. Thus the energy in running water and wind was put to good use.

Energy is of different forms. An important one is mechanical energy which can be divided into potential and kinetic energy.

A body possesses potential energy because of its state or position.

Energy can also be stored in a stretched spring, or elastic materials or a compressed spring. Thus human energy can be converted and stored as potential energy in a catapult or a clock spring.

Any moving body has kinetic energy. A spinning flywheel has kinetic energy.

Some examples of Energy in use

Waterwheels and Electrical Energy

Water flowing downhill has its potential energy changed to kinetic energy. This rushing water hits the blades of a water wheel and transfers the energy into mechanical energy. Thus buckets attached to the wheel can raise water for irrigation. What can you say about the speed of the water before and after hitting the wheel?

Electricity is also produced by converting the mechanical energy into electrical energy.

The Solar Panel

This is a device used to collect the heat from the sun's rays. Figure 1 shows a simple diagram of a solar panel. Water flows through pipes under a plate of glass. These pipes are blackened to absorb heat from sunlight. Convection current helps the water to circulate.

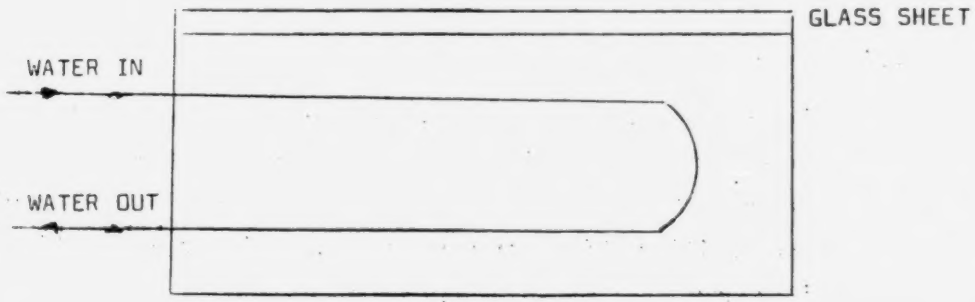


Fig. 1

The glass plate ensures that the heat is trapped inside the panel (green house effect) and hence is transferred to the circulating water.

These absorbers are easy to build and best used in a slanting position on the roof.

The problem with solar energy is that most of it is available during summer. However solar panels can also be used in winter (as long as it is not cloudy) to heat water for domestic purposes.

Its use is limited as the water does not produce steam sufficiently to drive turbines for mechanical energy.

Solar Cells

These are devices usually made from silicon to convert the sun's energy directly into electricity. They are used in spacecraft and satellites to power the equipment on board. They are however very expensive to produce. An array of these cells can be laid on the roof like the solar panel. However the energy will have to be stored in batteries for use at night.

Solar Furnaces

Mirrors or polished metal reflectors (e.g. aluminium and chromium) are arranged in a concave parabolic shape to focus sunlight on to an object. Temperatures of 1000^{o}C and over can be reached. A small furnace e.g. of two square metre area provides energy equivalent to an electrical hot plate. They are currently used in some parts of the world for cooking food.

Large scale solar furnaces, have been used to boil water and hence generate electricity through steam turbines.

Wind Energy

This is the energy from the sun. As more heat reaches the equator than the poles, it rises up and thus convection currents are set up. The convection currents have been utilized by windmills and sailing ships for many years. Being very unreliable, windmills have been replaced by steam.

Recently however, there have been attempts to build large scale aerogenerators.

Windmills are still used today to generate electricity and pump water from wells.

Converting Energy from one Form to Another

Energy exists in different forms and it can be converted from one form to another form. In nature, plants convert the sun's energy to chemical energy and when burnt heat energy is liberated.

However, energy can also be converted to a useful form in machines which help us to do work. One important machine, is the car, where the engine is the main energy converter.

Petrol or diesel oil which stores chemical energy is burnt thus releasing heat energy, which is in turn converted to mechanical energy which makes the car move.

In the cooking stove, gas (chemical energy) is burnt to liberate heat energy.

Principle of the Conversion of Energy

This principle states that energy cannot be created or destroyed. It can only be converted from one form to another.

However, some energy appears to be 'lost' whenever a conversion is taking place. In a car not all chemical energy in the petrol or oil is used to propel the car. Most of it is lost to the surroundings as heat energy, sound energy, wind energy.

Efficiency

The efficiency of a machine is the ratio of useful energy output to that of input.

In a cooker the energy in the gas, electricity or wood is not all utilised, e.g. to boil water or cook food. Some is lost to the surroundings. In order to make it most efficient, it is important to minimise the heat lost to the surroundings. How can this be done?

Conduction

This is how heat travels through a material. How much energy will travel through depends mainly on

(a) the type of material
(b) the area exposed, e.g. to the sun or heat source
(c) thickness of the material.

In a house we cannot control all these, except the material used. Corrugated iron sheets are good conductors whereas sugarcane straws are not - they are insulators. In roofs of similar sizes, one of iron sheets will conduct heat about 500 times more than a thatched one.

Write down a list of insulators and conductors. How would you insulate your house to keep it cool in summer?

Convection

When air becomes hot, it rises and cold air flows to take its place. Hence a circulation of air is set up. This is called convection current.

Activity

1 Take a tin can and make a hole at the bottom as shown in the diagram below (Fig. 2).

2 Place a burning candle as shown.

3 Place your hand near the top. Can you feel hot air rising?

4 Now take a piece of paper soaked in petrol, light the paper and place it near the hole at the bottom.

5 What do you observe? Black smoke from the bottom of the can will escape at the top.

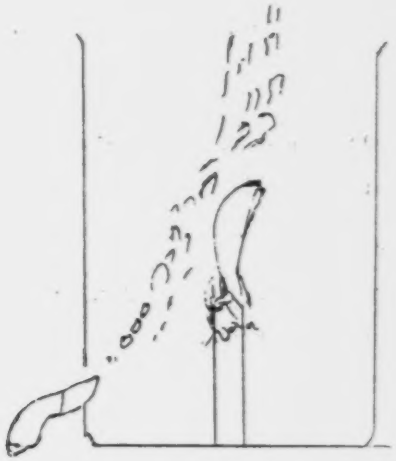


Fig. 2

Radiation

All objects radiate heat - some are better than others. Good radiators e.g. black, rough surfaces are also good absorbers.

White shiny surfaces are however good reflectors of heat. Solar collectors, panels are thus painted black. If your house roof is made up of corrugated iron sheets, what colour would you paint it to keep your house (1) warm?
(2) cool?

Measurement

Heat energy is measured in calories. A calorie is the amount of heat required to raise the temperature of 1 gm of water through $1^{\circ}C$.

How many calories are required to raise the temperature of 1 litre of water from $15^{\circ}C$ to $100^{\circ}C$. (1 litre of water ≡ 1 kg).

Calorific Value of Fuel

When a substance such as paper, wood, charcoal etc. is burnt, it gives off a certain amount of energy in the form of heat.

The amount of energy given off by 1 kg of the substance when it is completely burnt is known as the Calorific Value.

Different substances have different calorific values.

Ignition Temperature

For a substance to burn, it must be heated to a certain temperature. It is then that it will catch fire.

The temperature at which this occurs is called the ignition temperature.

When a substance is kept below the ignition temperature, it will not burn.

Heat Capacity

Different substances get heated at different rates, e.g. the temperature of water rises slowly because it requires a large amount of heat energy: whereas for a metal, the temperature rises more quickly because it requires less energy. Hence we say that water has a large heat capacity and the metal has a low heat capacity.

Activity

1 Take a beaker and fill half of it with water.

2 Measure the temperature of the water.

3 Place the beaker and water over a flame and allow it to heat for three minutes.

4 Record the temperature of the water again.

5 Repeat the above experiment, now replacing the water by oil.

6 Which temperature is higher, that of water or oil?

The temperature of oil is higher than that of water. The same amount of heat causes the temperature of oil to rise much higher than that of water. Therefore the heat capacity of oil is less than that of water.

C DESIGN, DRAWING AND DEVELOPMENT

What is design and designing

Man is continually making changes in the world around him. Sometimes he adds, sometimes he takes away. Whatever he does has some sort of effect on himself and on his fellows - for better or for worse.

Whether you think any particular change is for the better or not, it is fairly certain that the change was made because someone felt a need for it.

In general terms we could say that design is a concept which relates to the process of finding an appropriate solution to a specific problem.

Let us refer to our project to elaborate on the term 'design and designing'.

Do we have a need? Yes - What is it?

The need is to save conventional energy and use a cheap form of fuel (e.g. bagasse) for cooking purposes.

Out of the need, then, there is a problem.

The problem is to design and make an appropriate burner which is to utilize bagasse, to be used as a cooking stove.

Usually the above problem is written in the form of a brief.

The design process is divided into various stages which are important in finding a solution to a problem.

The main stages of the design process are:

(A) Brief
(B) Investigation OR analysis
(C) Synthesis
(D) Realization and testing
(E) Final solution.

Brief

The brief is a statement of the problem we want to tackle and which arises from a specific need.

It is very important that the brief is detailed so that there is no confusion in interpretation.

For our purpose a suitable brief could be·

Design and make a device that will use bagasse efficiently for cooking purposes.

Therefore our real task is to think about designing and making a device (a burner is an appropriate term here) to burn bagasse to produce heat.

In the investigation or analysis stage we really explore possibilities and ask questions about many factors that have to be carefully considered before the making of the bagasse burner. Some of the factors that are worth analysing are listed below:

(1) Material(s) to use
(2) Size of burner
(3) Shape of burner
(4) Amount of bagasse to be used
(5) Cost of burner
(6) Method of constructions
(7) Bagasse to be used in powdered form, compressed or pelletised form
(8) Burning time and amount of heat energy given out by burner
(9) Efficiency of burner
(10) Method of holding or supporting cooking utensils over the stove
(11) Does the burner require maintenance?
(12) The appearance of the burner (type of finish for example).

The synthesis stage is that stage of considering the appropriate ideas, tools, techniques and processes which we have to combine intelligently before realizing or making the burner. Once the burner has been made there is a need to test it and in the light of findings from the test to modify and redesign the bagasse stove and come up with a proper unit that will function properly (final solution).

Let us now consider the factors listed above, analyse them to find out how we could come to make the bagasse stove.

Some materials that can be considered are:

1 concrete
2 copper
3 galvanized steel
4 mild steel
5 aluminium.

An analysis of the characteristics and properties of the above materials will reveal that only mild steel can be utilized to produce the bagasse burner, for the other materials have the following limitations. For example:

1 Concrete

relatively expensive, heavy and needs intricate mouldings to manufacture.

2 Copper

very expensive.

3 Galvanized steel

the heat will burn away the galvanized or zinc coating.

4 Mild steel

Black mild steel gauge 19 or 2 mm thick could be used. Black mild steel (BMS) is relatively cheap, easily available and could be readily formed into the required shape.

We could also make use of old cylindrical containers (oil, grease or paint) to manufacture the burner. Empty or used cylindrical containers are easily available and would bring down the cost of the bagasse burner. For our purpose we will, as far as possible, make use of these types of materials.

Size of Burner

This would influence the amount of bagasse put in and the amount of heat produced. If the burner is to serve a large family, then the approximate size of the burner would be around Ø 260 mm x height 350 mm.

Experiments have shown that once firing of the bagasse has started it is preferable to allow the whole bagasse to be consumed away. It is not practical to extinguish the burner for re-use. Could you suggest why?

Method of Construction

There are many processes that have to be carried out in the making of the bagasse stove. Some of these are:

1 Forming
2 Welding (for the top support)
3 Riveting
4 Use of assembly techniques such as bolts and nuts and straps.

Which of the above techniques or processes you will use and why?

A former should be designed on which the mild steel could be bent to produce the required shape, if sheet material is utilised.

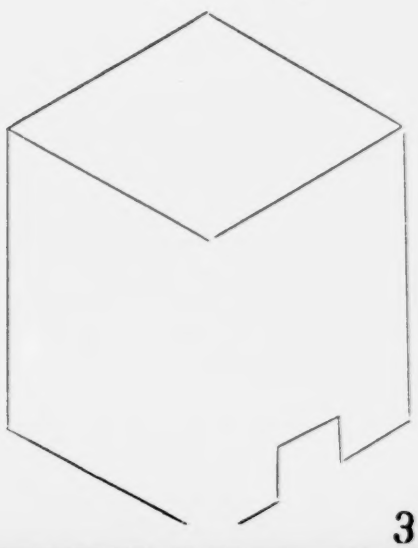
How would you make a former?

Riveting is preferred as it provides a strong mechanical joint and is not expensive; again this process will be utilised if sheet material is used.

There are many methods of welding. For this purpose electric arc welding is preferred because it gives a strong joint.

Shape of Burner

The shape of the burner could be either cylindrical or rectangular. This is illustrated in Figures 3 and 4. In the process of making the burner, we could actually produce the 2 different types of burners to show techniques employed in their manufacture.



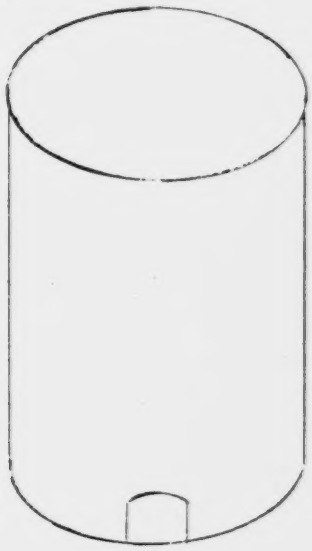


Fig. 4

Pelletized or Powdered Bagasse

Bagasse is obtained in compressed block forms (600 x 600 x 600 mm). In order to feed the burner with bagasse, the latter should be broken into small particles. Before feeding bagasse into the unit, it is preferable to spray some water on the bagasse. The water will act like a bonding agent and will allow the bagasse to stay in position when being fed in the burner.

Rate of Burning of Bagasse and Efficiency of Burner

The rate of burning of bagasse will depend mainly on the amount of air or draft within the system, that is the burner.

The draft system should be incorporated in the burner to feed a plentiful supply of air which will help the bagasse to burn efficiently. A vent at the lower part of the burner and an air duct centrally through the bagasse will do the job. This is illustrated in Fig. 5.

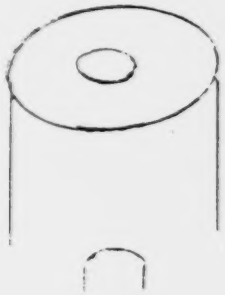


Fig. 5

Method(s) of supporting or holding cooking utensils over the stove

Think about ways of supporting cooking utensils on the bagasse burner.

What materials are ideal?

How to manufacture the supporting device?

Fig. 6 shows, in orthographic projection, the methods of the supporting device. There are many other ways of doing the same job.

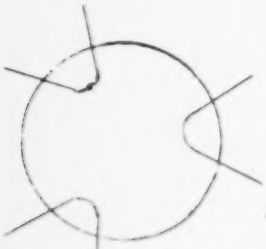


Fig 6(a)

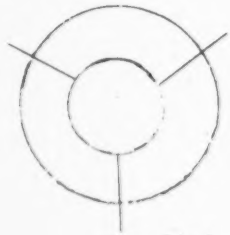


Fig 6(b)

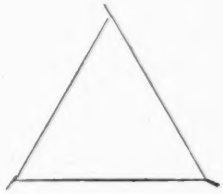


Fig 6(c)

Construction mild steel bar Ø 6 mm is an appropriate material because it is cheap and easily available.

Welding techniques have to be utilized for making this device.

Finish and Maintenance of Burner

Ash from the unit will need to be removed regularly before any fresh supply of bagasse is fed in. This should be carried out when the burner is in a cold state.

What type of finish would you recommend for the stove?

Painting is not a wise decision since the heat will burn away the paint. Therefore we have to leave the burner in its natural state.

Drawing and Development

Many times, when we wish to express ourselves, we make use of sketches and drawings.

The use of sketches or drawings, together with signs and symbols (Graphical Communication) is an appropriate mode of communication. This form of communication has the following advantages:

(1) Universally understood

(2) Clear and concise

(3) Quickly read or interpreted.

Sketching Techniques

The ability to sketch freehand with a pencil is not only essential to anyone considering a career in engineering or art, but is a useful asset for anyone to have.

Anyone can learn to sketch - it is mainly a question of practice. Here are two essential points that you should observe when you start to learn to sketch:

(a) You need a good HB pencil sharpened to fine conical point.

(b) Do not press hard with your pencil - when you are satisfied with your sketch, it is then that you press with the pencil to draw the outline of the picture you have drawn.

It would help you to sketch properly if you could use your pencil to sketch the following straight lines, curves, profiles or letters and diagrams (Fig. 7).

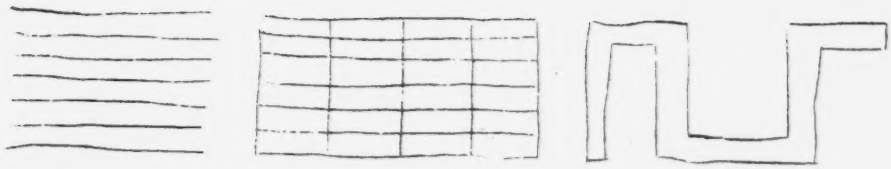


Fig 7(a) STRAIGHT LINES

Fig 7(b) CURVES

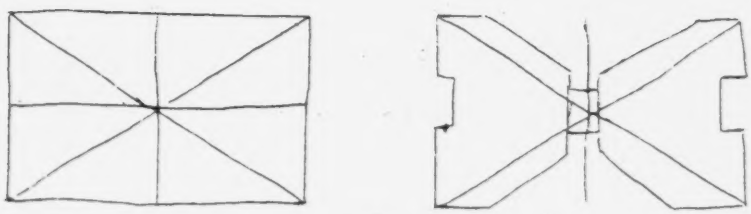


Fig 7(c) PROFILES

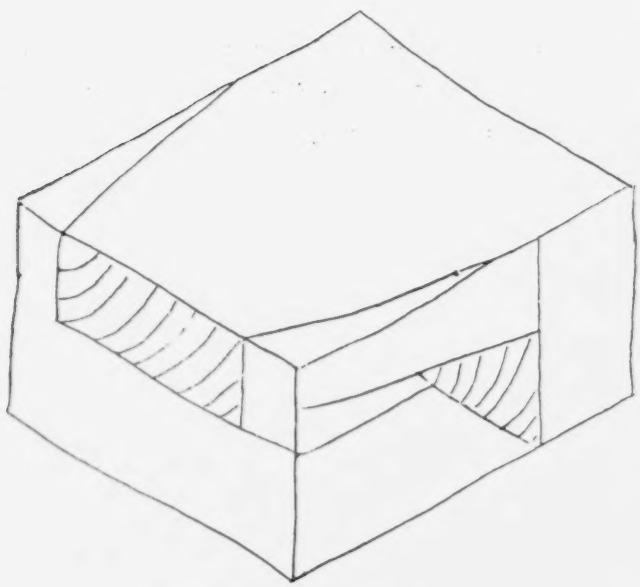


Fig 7(d) ISOMETRIC SKETCHING

Three dimensional sketches are best attempted if grid paper is available. When making 3D sketches it is important to observe and be able to reproduce the correct proportions of the real object.

A useful exercise for you when practice 3D sketching is to draw simple common objects that you see at home.

Isometric Drawing

An isometric drawing is a pictorial view which shows three faces of an object simultaneously.

In producing such a drawing, it is advisable first to draw up a rectangular 'crate' which represents the smallest rectangular block from which the object could be made. In doing this the isometric axes and planes on which the drawing is built up are established.

Figure 8 shows a series of drawings which describe how the isometric drawing of a stepped block is produced.

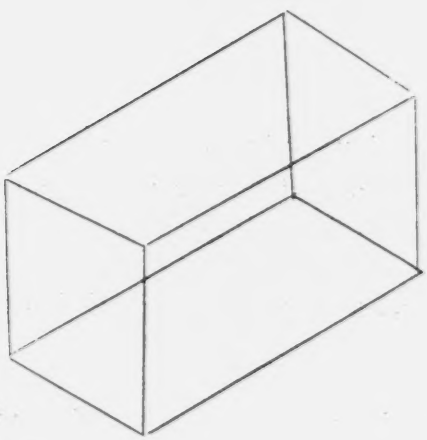


Fig 8(a)

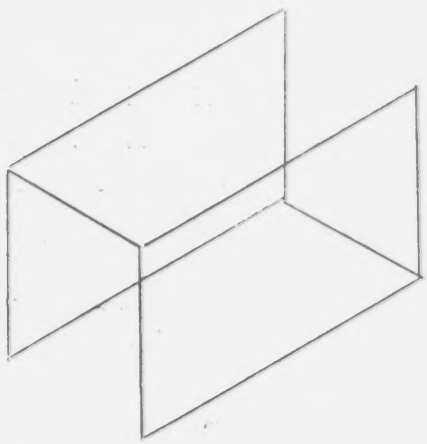


Fig 8(b)

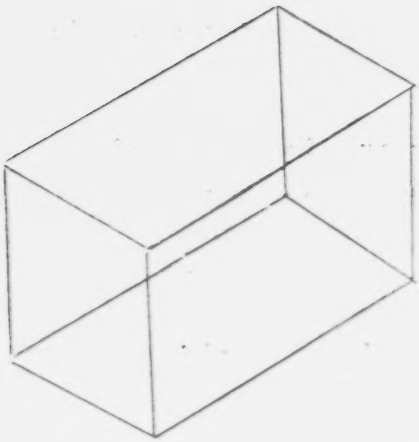


Fig 8(c)

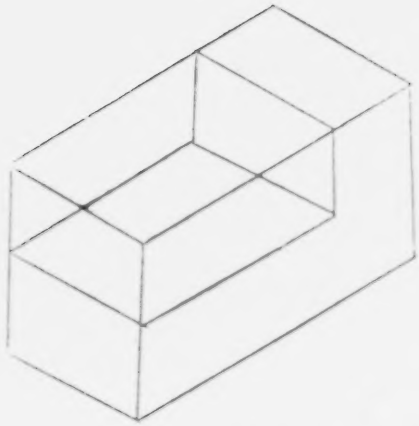


Fig 8(d)

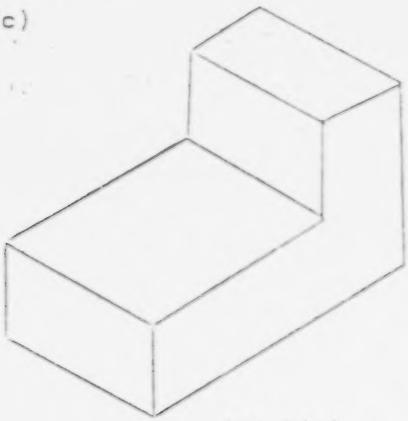


Fig 8(e)

Orthographic Drawings

Orthographic drawings give views which are produced by observing separate faces of a component in order to demonstrate all its features.

The separate views are usually arranged and positioned on a paper in a systematic manner.

The series of drawings in Figure 9 show a pictorial view of a component together with the three common views drawn in orthographic projection.

Notice how projection lines help to draw objects in orthographic projection.

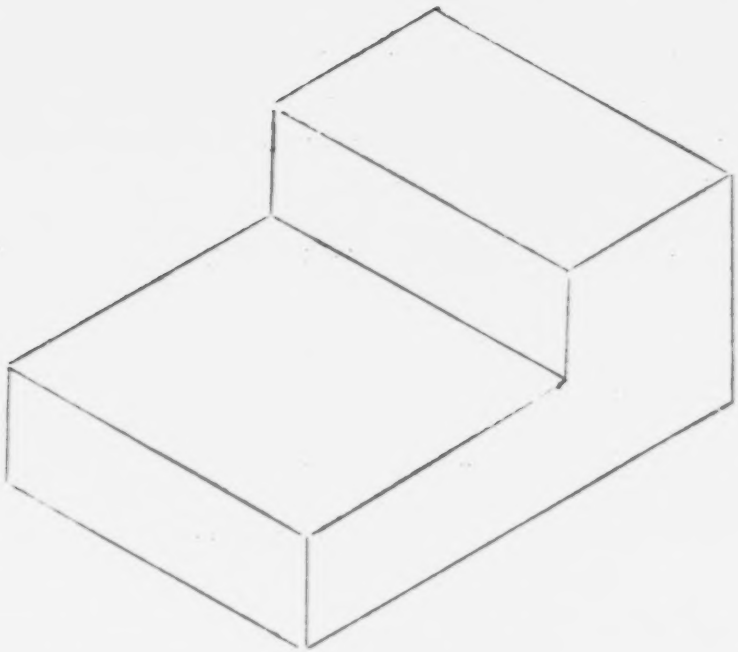


Fig 9(a)

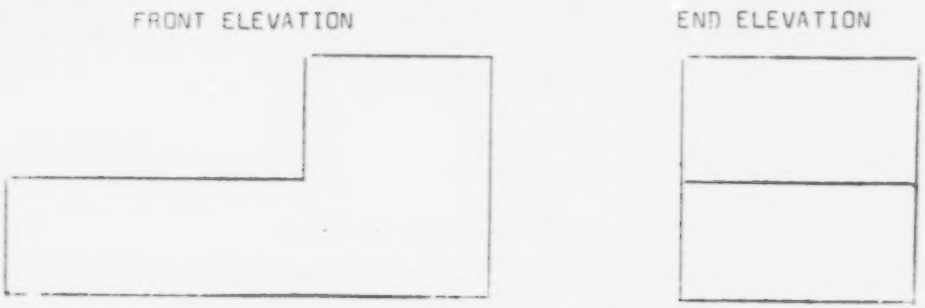


Fig 9(b)

Development in Drawing

Many items such as metal and card boxes, funnels and ducts are made from flat sheet materials. These materials are either rolled, folded or bent in order to make the final object. Since a definite shape or pattern and size is required, our task then is to draw a development drawing of the object to show the complete surface or surfaces laid out on a flat plane.

The development of an object, if intelligently done, will enable us to know exactly how much material is required to make the object and will also guide in the actual manufacture of the object.

Figure 10 shows the development of a simple box.

Could you make the development of the bagasse burner you have to manufacture?

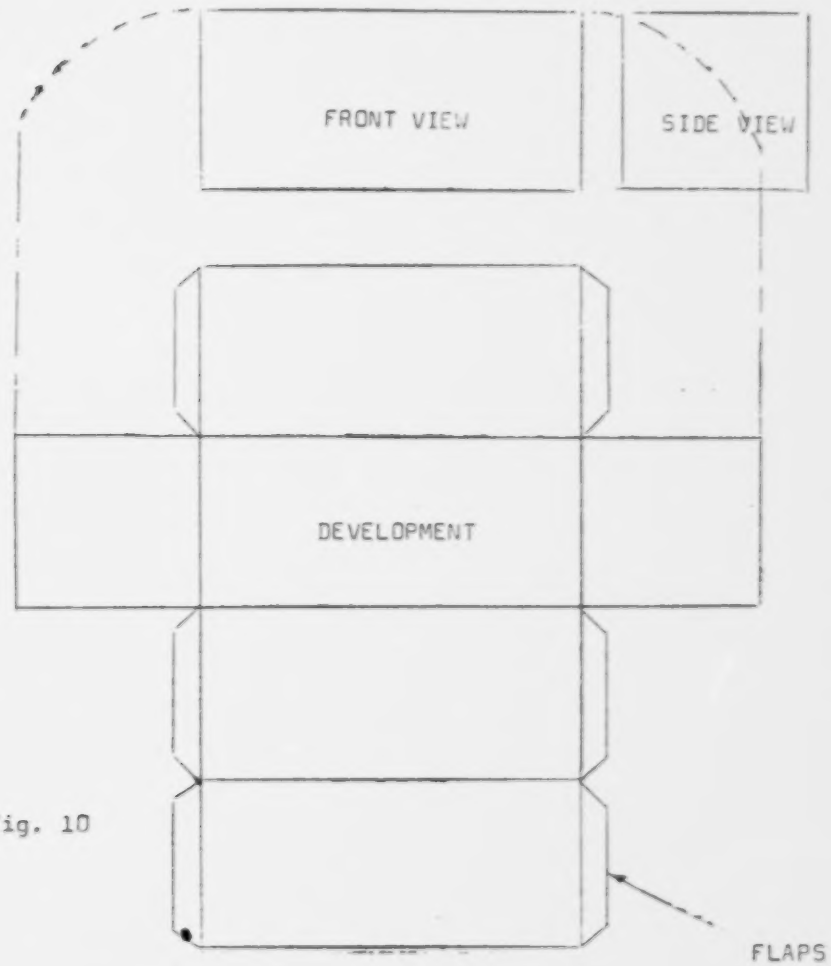


Fig. 10

Reading and Interpreting Working Drawing

A working drawing gives all the instructions which the craftsmen require in order to make the article. For practical purposes, the drawing is usually an orthographic projection of the article.

Amongst other information, a working drawing should contain the following key elements:

(a) Dimensions of object
(b) Scale used
(c) Material to be used for making object
(d) Drawing number.

Figure 11 gives an example of the type of working drawing we should have recourse to before the actual manufacture of the bagasse stove starts.

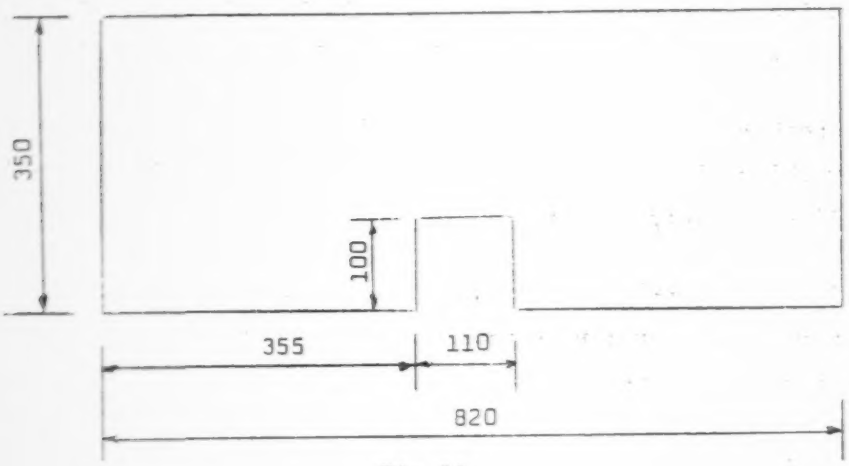


Fig 11

Project	-	Bagasse Stove
Material	-	Mild Steel Sheet
Dimension	-	In mm
Scale	-	1:8
Date	-	5.2.85
Drawn by	-	B.D.

D WORKSHOP PRACTICE AND TECHNOLOGY

Any person working in a workshop needs to know how to measure and mark whatever work he is doing.

The most common measuring tool is the metric rule. It is graduated in mm and cm. (1 cm = 10 mm). You will be using the metric rule in the making of your project.

Using the metric rule then you will have to mark your work and there are some basic bench tools to do that.

The most common bench marking-out tool is the scriber. When working, it is required to have two faces or two edges at right angles and the engineer's square can be used to test squareness. You can also use it to draw with a scriber, a line at right angles to an edge.

Dividers are extensively used for drawing arcs and circles. The centres of the arcs and circles are slightly punched using a centre punch. Rest one tip in this depression and after adjustment of the radius, scribe the arc or circle.

Another marking out tool, extensively used in sheet metal working, is the odd-leg caliper. You can use it for scribing lines quickly parallel to an edge.

In metal working, many edges on your work are required to be straight. A ruler or square has straight edges for you to check your work.

Activity

1 Take a piece of scrap sheet metal. Select a straight edge. Check for straightness. Select an adjacent edge and check for squareness. Scribe a line perpendicular to a straight edge. What precaution would you take to ensure accuracy?

2 Using odd-leg caliper, scribe a line parallel to and 20 cm from a straight edge. Practice drawing some more lines parallel to the edge. What will happen to the scribed lines if the edge is slightly curved?

3 Punch lightly a dot somewhere in the centre of your scrap with your centre punch. Using your dividers, try to draw some concentric circles with the dot as centre.

Why is it necessary to dot punch the centre?

Some more Measuring Tools

Outside and inside calipers are also important tools to be found in the workshops. Inside calipers are used to measure internal gaps not accessible to a ruler. Outside calipers are used to measure outside dimensions e.g. the diameter of a round bar.

Tools for measuring, marking out and checking are precision tools. What precaution would you take to ensure the accuracy and long lasting life of each of the tools that you have learned to handle in this lesson?

TOOLS USED IN THE PROJECT FOR WORKING METALS

Cutting Sheet Metal

Once you have marked your work, you will have in some way to shape and process it to get your component.

Many tools exist for doing this type of job, but you will be using only some bench tools for that.

A pair of hand snips is most suitable for straight or curved thin sheet metal. For heavier thicknesses you may find it difficult with snips/shears. A bench shear, if available, may help because of the leverage in the cutting action. Otherwise you will have to use a cold chisel and hammer.

Cold chisels are available in different forms, e.g. cross-cut, diamond, flat: but for an ordinary cut in sheet metal, flat chisel is used.

You can place your work on a backing piece of wood/metal but whenever possible hold it in a bench vice and shear the metal using a hammer on the chisel.

Bending of Metals

In this project you will have to bend both sheet metal for the stove and round bar for the support of cooking utensils to be placed on top of the stove.

Sheet metal is best formed into a cylindrical shape by passing it through a pair of rollers. As this may not be available in a workshop, it can be formed using a curved block of wood or metal as a former.

Bend the major part of the sheet over the former by hand. The part near the edge is more difficult to form. A wooden mallet or hammer will help to form the difficult parts.

Overbend the formed sheet slightly so that the seam overlaps by about 25-35 mm. The seam will then be joined permanently later using rivets.

Can you think of ways to bend sharply a piece of sheet metal?

The parts forming the support to be placed on top of the stove needs to be cut, bent, and welded together. For sharp bends, place the bar in the vice at the bend line. Hammer it then to shape.

Curved/circular parts will need to be hammered out on the anvil. Using the beak of the anvil, the metal is hammered and at the same time moved slowly until the required shape is achieved.

Methods of Joining Metals

Different methods exist and two most suitable for joining metals in the project will be introduced, namely - welding and riveting.

Both methods produce permanent joints that will stand high temperatures.

Riveting as you will find is most carried out on sheet metal and so will be used for joining the seam. Rivets are available with different types of head e.g. round, countersunk and in different diameters e.g. Ø 1.58 mm, 2.38 mm, 3.2 mm, 6.35 mm etc and in a wide variety of metals e.g. soft iron, copper, aluminium and round mild steel; soft

iron rivets Ø 2.35 mm - 3.2 mm will be used for your project because these rivets are cheap and easily available.

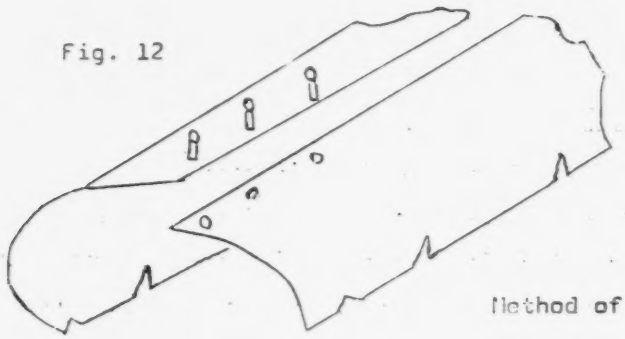
In order to join two metals together using rivets, a hole must be drilled in each of the parts and a rivet inserted into the hole. The rivet is then squeezed 'flat' using the ball pein of a hammer working round the edge of the rivet until the parts are securely held together.

If two or more rivets are used, one rivet first fixes the parts together which are then aligned and then another hole drilled for the rivet and so on. Precaution must be taken for two holes to be in line so that a rivet can be inserted in them.

Rivets must be well and equally spaced to share the load they are to carry, and the diagram (Fig. 12) shows the most appropriate way to space your rivets.

Think of other ways to join the seam of the stove. Why don't we use glue, soft solder, or brazing?

Fig. 12



Method of riveting

How can we reinforce the lower and upper ends of the cylindrical stove? A steel band would be most appropriate. How will you rivet it on the stove?

The easiest way to make the support is to join the parts by a process called electric arc welding. Attach the negative electrode to the work and adjust a piece to it ready for arc welding. A little space ($\frac{1}{2}$ the Ø of the round parts) will help the water metal to run and form a good thorough weld.

Hold the welding rod as shown, strike the arc and weld maintaining the angle of rod to work. With what is the rod covered and why? What is the difference between right hand and left hand welding? (See Fig. 13).

A few runs of weld in each joint gives a strong joint. Descale the flux prior to each run.

Safety is important in the welding shop. Appropriate glasses help to protect the eyes. Wear them. Wear also leather boots, apron to protect yourself against spurts of molten metal.

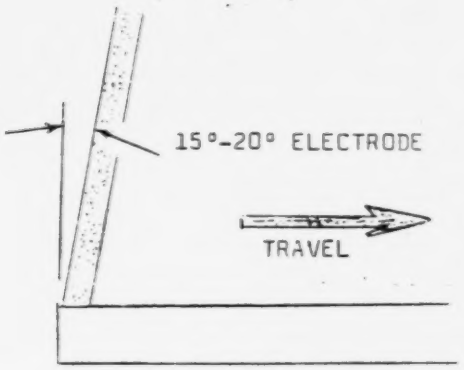


Fig 13

MATERIALS USED IN THE PROJECT

The material used in the project is steel. In sheet form, steel is used, after developing the shape flat to form the body of the stove. In rod form it is cut to different lengths and after bending and adjusting, these lengths are welded together to form the support on top of the stove.

The type of steel that we are going to use is mild steel. It is a steel that is fairly soft and can be cut, bent, drilled etc easily. It is also cheaper than other metals, e.g. aluminium, copper etc. The melting point of mild steel is high (about 1600°C) and therefore it can be safely used as a material to build the stove. The only disadvantage of its use is that it rusts with time and hence it is not very long lasting.

Aluminium though long lasting, is expensive and melts at a low temperature (700°C) and it will therefore soften if used to build the stove. Copper is softer than steel and easy to work but it is too expensive and thus does not justify its use.

Metals can be bought in different shapes and sizes. Common shapes available are squares, flats, strips, rounds, hexagonal and sheet.

Round bars are measured by diameter and they exist in wire form or bars. Wires are bought in reels, but over 4 mm, rounds are sold in lengths for convenience e.g. 6m and 10 m. Sheet metals are ordered in thicknesses varying from less than $\frac{1}{4}$ mm to 8 mm usually, though thicker ones are also available. They are measured in S.W.G. (Standard Wire Gauge). S.W.G. 36 is the thinnest and S.W.G. 1 the thickest.

Sheet steel is available in its ordinary black form, or galvanized or tinned. In the galvanized form it is coated with zinc to protect it from rusting. Sheet steel in this form is sometimes corrugated for use on roof tops. In the tinned form it is coated with tin and is mostly used in tin cans.

Can you suggest why we use black mild steel in the project?

SOME SAFETY PRECAUTIONS TO OBSERVE IN THE WORKSHOP

1 Use tools and equipment which are in good working order.

2 Do not attempt to use tools or equipment if you do not know how to use them; ask for operating instructions.

3 Wear goggles when operating the drilling machine.

4 Use appropriate holding devices or jigs to secure jobs on drilling machine while drilling sheet or plate materials.

5 Make sure that drills are secured tightly in drill chucks before drilling operations.

6 The sharp edges of mild steel are dangerous. Handle mild steel and sheet materials with extreme care.

7 While bending, hold bending former securely in vice.

8 Wear appropriate footwear, goggles and protective clothing during the welding process.

9 Be sure that there is adequate ventilation in the welding shop.

10 Chisel heads must be free from burns (mushroom heads) and when chiselling, care is needed to ensure that chips do not fly.

11 Tools should be laid out on the bench methodically and not thrown on top of one another.

12 Accidental cuts and scratches should be reported immediately to prevent infection.

TESTING AND IMPROVEMENT OF THE BAGASSE BURNER

After you have made the bagasse burner, it is essential that you carry out simple experiments on the unit to find out to what extent the device you have designed is performing efficiently and how to improve its design.

Here are some examples which you may try out, but do not hesitate to explore other possibilities. When you are conducting experiments or tests, try to be as systematic as possible with your procedure and particularly with your method of collecting evidence or data.

1 Try to use materials other than bagasse viz. saw dust, chopped grass, water reeds, filao and pine seeds and cow dung. Note that the materials that you use into the burner should undergo some treatment before they are fed into the burner, e.g. chopping, drying, compressing and mixing.

2 Find out which of the materials you have selected 'give more heat energy'. How would you do that?

3 Explore the possibilities of controlling the flame (or the heat energy) liberated in any given time when the burner is in use.

4 The burner is 'on'. You decide for one reason or another not to use the burner. How would you save the bagasse or other material that has been fed into the unit.

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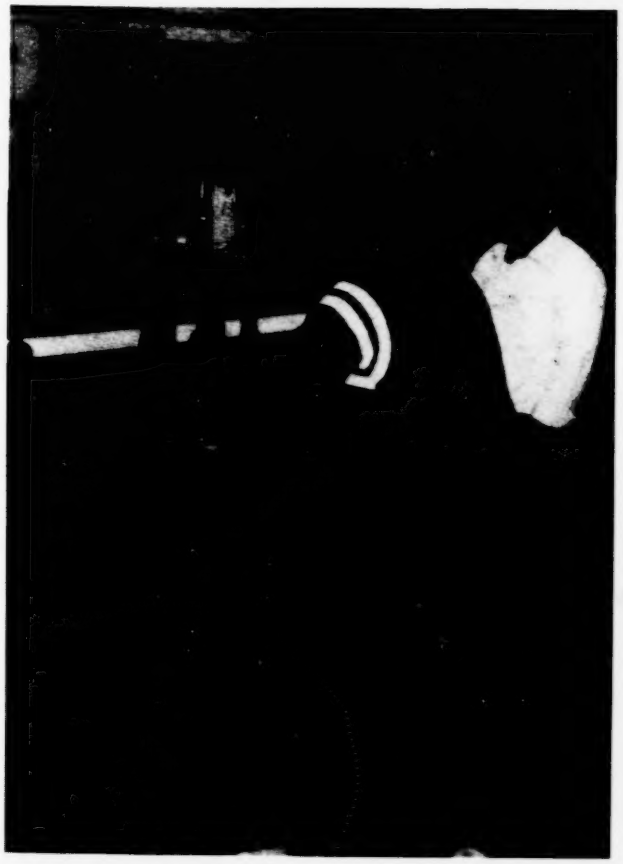
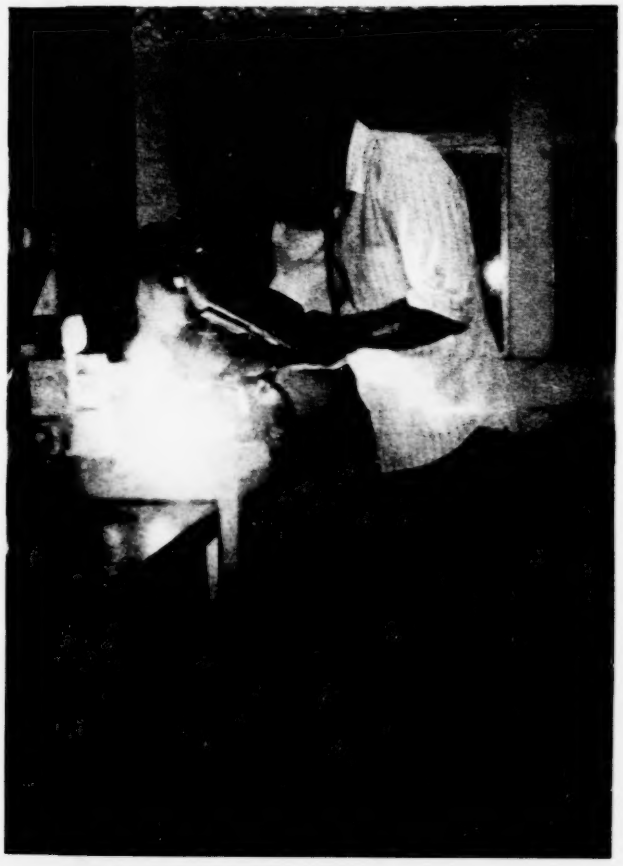
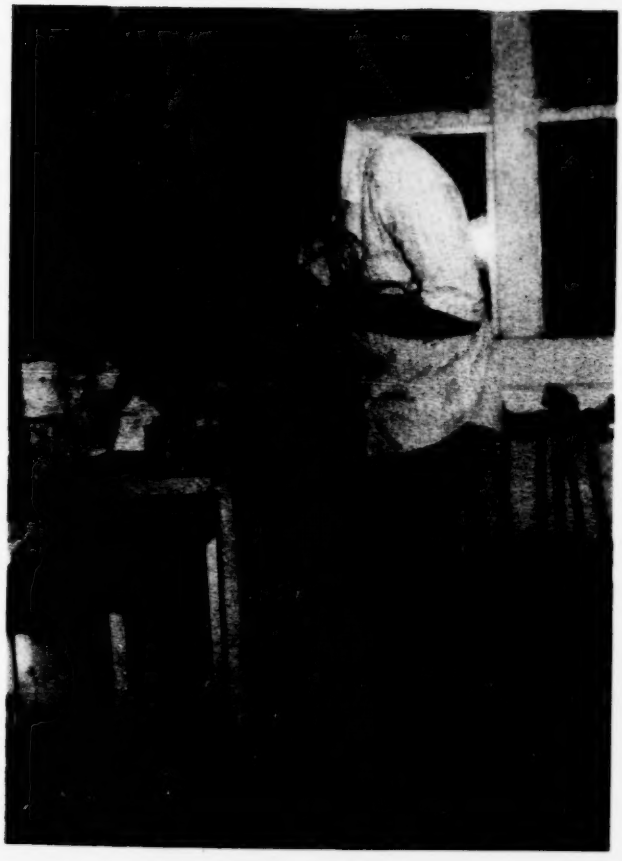






PRESERVATION OF FOOD

Fruits and vegetables grow, mature then deteriorate and decay. Some foods are available during the growing season only. These foods should be preserved when available in large quantities and stored for use when they are out of season.

Aims and Objectives

The main aim in preservation is to preserve food when it is most nutritious so as to prevent its decay (the action of harmful yeasts, moulds and bacteria on it) and so that it may be used when fresh food is not available.

The general aims of preservation are:

(a) to keep food in good condition

(b) to keep the maximum taste and nutritive value

(c) to save foods when they are in season or in abundance, thus reducing wastage and saving money

(d) to know how to prevent and control contamination by destroying the organisms causing decay and to prevent any fresh organisms reaching the food.

Specific Objectives

Participants should be able to know:

(a) how to recognise food that is no longer safe to eat

(b) how and why food becomes unsafe or goes bad

(c) how to keep food in good conditions.

Important Note

It is useless and it may be very dangerous to try to preserve food which has already deteriorated.

How can food be kept safe?

Food undergo changes which make them unfit for consumption. These changes are due mainly because of the action of enzymes in the food and the growth of micro-organisms that contaminate them. Refer to Activities at the end.

Causes of food deterioration

Food may be spoiled by the action of micro-organisms and enzymes.

1 Micro-organisms are very, very small living things which can get into food or on its surface. These micro-organisms need 3 things for their growth : (i) warmth, (ii) moisture, and (iii) air. There are 3 main types of micro-organisms that deteriorate food: (a) bacteria, (b) moulds, and (c) yeasts.

2 Enzymes are chemical substances present in the food itself. We have seen the action of enzymes on cut vegetables and fruits when exposed to air. Some enzymes cause fruits and vegetables to ripen, then decay and return to the soil which they may enrich so that other plants may grow.

3 Foods may be spoiled by unhygienic habits, e.g. food handling - Re. Activity II. Food sanitation.

Different methods of food preservation

(A) Methods which kill micro-organisms:

(i) Heat sterilization e.g. bottling.
Food is packed into containers, sealed and sterilized.

(ii) Pasteurisation.

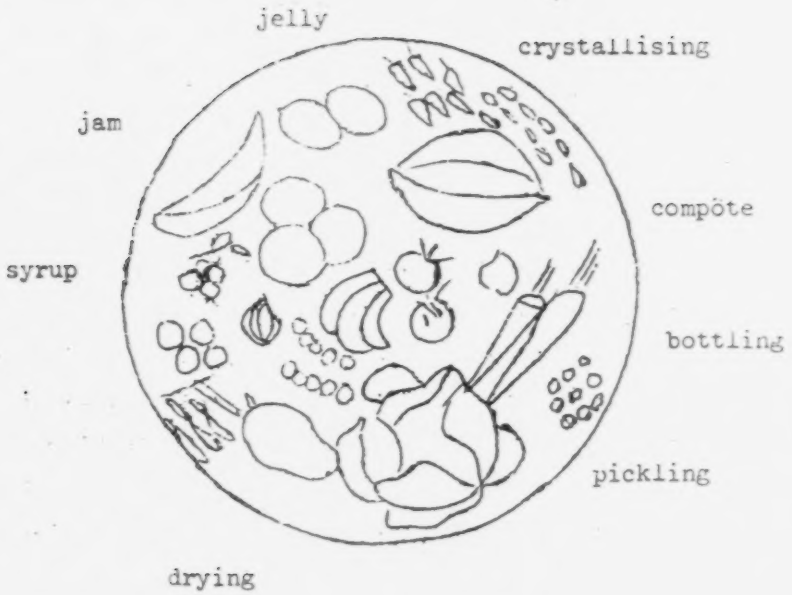
(B) Methods which stop activity of micro-organisms:

(i) Drying - by sun and wind, hot air

(ii) Freezing - lowering of the temperature of food

(iii) Preserving Agents - substances which control the activity of micro-organisms, e.g.

- SALT = vegetables & fruits, beans, meat
- SMOKE = fish
- ACID = chutneys, pickles, sauces
- SUGAR = jam, jelly, crystallised fruit syrup
- PRESERVATIVES = Re. Science e.g. sulphur dioxide.



1 Drying

Drying removes water from vegetables and fruits and prevents the action of enzymes and micro-organisms e.g. dried herbs, dried chinese cabbage (ham choy), dried fruit, dried chillies. Vegetables are also dried in the sun before making vegetable pickles.

2 Low temperature: Cold storage and freezing

Refrigerator

Refrigeration is used for temporary preservation of vegetables, fruits and cooked foods; however, food can be kept for a few days only in a refrigerator.

Freezing

Bacteria and enzymes are inactive at freezing temperatures. Meat, fish, vegetables and fruits can be frozen and kept for a few months in the freezer. The important point to remember about freezing is that the micro-organisms will be active again as soon as the food is thawed. Therefore, frozen food must be used as soon as it thaws and NEVER RE-FROZEN.

3 Use of preserving agents

Sugar, salt, vinegar, oil and spices are useful chemical preservatives, as they make foods unsuitable for use by micro-organisms without making them unfit for human consumption.

Sugar

Sugar must be used in large quantities to act as a preservative. The sugar used in preserving helps to keep the natural fruit flavour and colour. A good high proportion of sugar is essential in jam and jelly-making, otherwise the jam or jelly may not keep. Cooking destroys the enzymes and micro-organisms and the 65% sugar solution used prevents the growth of any micro-organisms that may enter from the air.

Salt

Salt, if used in sufficiently large quantities make food unsuitable for the growth of micro-organisms without destroying its food value. Preservation in brine is largely used for vegetables when making pickles.

Vinegar and salt

Both vinegar and salt are used in pickling fruit and vegetables. Vinegar prevents the development or harmful micro-organisms.

Oil and spices

Oil and spices used in pickles act as preserving agents.

4 Use of heat

Sufficient heat must be applied to destroy micro-organisms without cooking the food to be preserved. The food must be sealed in an airtight container. People who have no refrigerator, heat their meat everyday to preserve it for some days. When there is a cyclone or when there is no electricity, meat has to be cooked with salt and spices and reheated each day.

ABBREVIATIONS USED

Teaspoon	t
Tablespoon	T
Millitre	ml
Centilitre	cl
Gramme	g
Kilogramme	kg

GLOSSARY

Agar-agar	la mousse
Cardamom seeds	elaichi
Cinnamon	cannelle
Clove	clou de girofle (gérofle)
Coriander seeds	cotomili
Cumin seeds	ti l'anis
Fenugreek	methi
Garlic clove	gousse d'ail
Methylated spirit	alcool à bruler
Mint	menthe
Mustard seeds	moutarde
Thyme	thym (di tin)
Turmeric	safran

&&&&

Blanch - plunge in boiling water

Sterilise - make free of micro-organisms/microbes

Sieve - tamis, piece of equipment used to remove foreign matter, lumps from food

Pectin - setting agent in jams and jellies

Scald - pouring boiling water over food

Micro-organisms - very small living organisms present in all normal surroundings, capable of growth and multiplication under suitable conditions. Precautions should be taken to prevent growth or organisms which will result in the spoilage of foodstuffs.

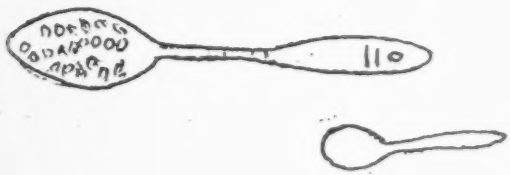
&&&&&&&&&&

EQUIPMENT

- A large saucepan - avoid copper and brass saucepans.

- Wooden spoon with a long handle so that it cannot slip into the jam, sauce or pickle.

- Large perforated spoon. Small spoon for tasting.

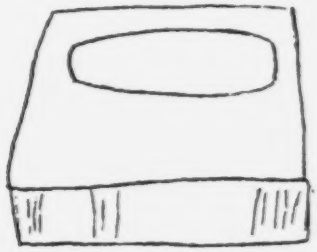


- Clean jars that are not chipped or cracked - old labels removed.

- Bowls - different sizes.

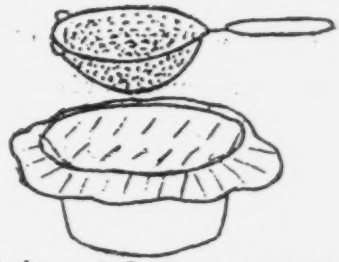
- Covers may be of cellophane paper- elastic bands.

- Roche carri or electric blender.



- Jug measure or large cup for filling jars and a saucer to catch any drips.

- Strainer, large bowl, muslin cloth for jelly-making.



- Methylated spirit and 2 glasses to test pectin.

- A saucer or a clean dry wooden spoon to test setting-point.

POINTS TO REMEMBER FOR ALL PRESERVES

1 Label all containers used for preserves - jars, bottles etc. with kind and date.

2 Use clean air-tight covers - cellophane paper, elastic bands or wax.

3 Store in a dry, dark, cool, ventilated place.
Excessive heat may cause shrinkage and damp encourages mould growth.

GENERAL METHOD FOR MAKING JAM

1 Select suitable fruit, good, partly under-ripe and free of bruises.

2 Wash the fruit to remove dust and soil and drain it.

3 Prepare fruit by removing any damaged parts, leaves, stalks and stones as necessary and by cutting, dicing or grating large fruit.

4 Wash the jam-jars using a detergent if they are really dirty, rinse them in very hot water and drain them; do not wipe them with a cloth. They should be perfectly dry. A metal spoon may be placed in the jar to avoid cracking when the hot jam is poured in.

5 Grease the sauce pan with butter to prevent fruit from sticking to the pan and also to prevent scum forming as the butter later floats on the surface.

6 Simmer the fruit gently in the water or juice. The sugar will later harden all fruit skins, so that unless they are softened at this stage, they will spoil the finished jam with their toughness.

7 Test the juice for pectin.

Good clot Fair clot Poor clot

Simmer fruit to extract pectin. Put 1 t juice into a glass and cool it. Pour 3 t methylated spirit and leave for 1 minute. One firm clot of juice indicates a high proportion of pectin, several smaller but firm clots indicate an adequate amount of pectin, thin broken clots show very little pectin.

8 Add the sugar to the fruit, stir it until all is dissolved.

9 Boil the jam quickly, stirring from time to time to prevent fruit from sticking and burning on the bottom of the pan and to prevent the formation of scum. The shorter the time taken to reach setting-point, the better will the colour and flavour be as the acid in fruit, with the sugar, produces a gradual change in flavour and colour.

10 Test the jam for setting-point.

TESTING THE SET OF JAM

To test if jam is set

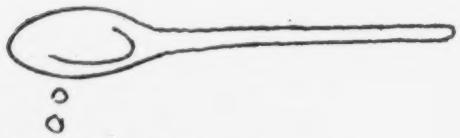
(i) The wrinkle test: put half a teaspoonful of jam on a cold sauce, cool it quickly. Push it with a fingernail across the saucer; if it forms wrinkles while still tepid, the jam should set.

(ii) The flake test: dip a clean dry wooden spoon into the jam, turn it above the pan to cool the spoonful of jam, allow the jam to run off the spoon; if broad flakes are formed and break off short, then the jam is ready: if it drops in a stream, it needs more boiling. (See diagram below).

(i)

cold saucer · jam wrinkles when moved with finger

(ii)



dropping with no flake

good flake

IMPORTANT POINTS TO REMEMBER IN JAM-MAKING

1 To obtain good results, fresh and firm-ripe fruit should be used; over-ripe fruit should be avoided.

2 Fruit that needs softening should be allowed to simmer gently before the sugar is added. Scald very acid fruits especially bilimbi, fruit de cythère.

3 To get a well-set jam pectin, acid and sugar should be present in the correct proportions.

4 Add sugar after the fruit is well cooked and broken down. After sugar has been added the jam should be boiled rapidly until setting point is reached.

5 To prevent fruit rising in the jars (especially bilimbi) the jam should be allowed to cool slightly in the pan and then stirred before filling the jars.

6 Overboiling with sugar may darken the colour, spoil the flavour and cause a sticky jam.

7 A syrupy or runny jam may be due to underboiling, to a deficiency of pectin or acid, or to the use of too high a proportion of sugar.

8 Fermentation in jam happens when underboiled or when there is insufficient sugar.

9 Scum should not be removed until the jam is made. Continuous skimming is wasteful and unnecessary.

10 Air-tight covers should be scrupulously clean and should be placed on the jars immediately after filling.

11 Pour the jam into hot dry jars. Label with name and date.

12 Store the jam in a dry, dark, cool, ventilated place.

STAGES IN JAM MAKING

1

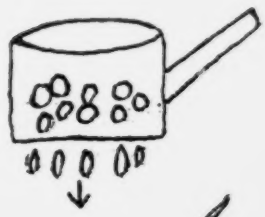
Use a good and reliable recipe. e.g.

- 1 kg bilimbi
- 1 kg sugar
- 150-250 ml water.

2

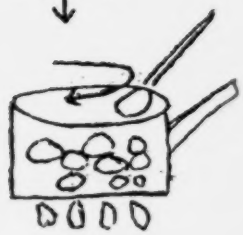
Choose firm ripe fruit; remove stalks, wash. Blanch very acid fruits e.g. olives, bilimbi, fruit de cythère.

3



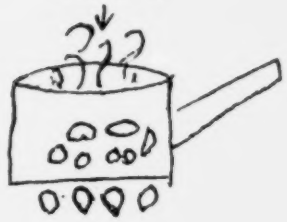
Add water (and acid if needed). Cook gently until soft and liquid is reduced. During this time the pectin is drawn out of the fruit.

4



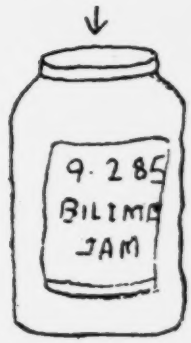
Add the sugar and stir over low heat until dissolved.

5



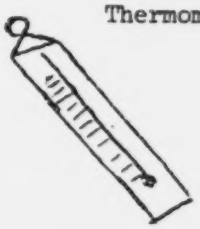
Boil rapidly without stirring - Some sugar is changed to invert sugar.

6

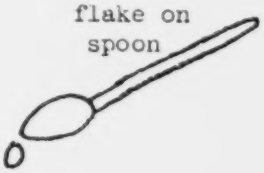


Test for set by one of these methods:

Thermometer 104°C.



flake on spoon



cold saucer jam wrinkles

when moved with finger

Jar well filled to avoid a large air-space

Pour into hot dry sterilised jars; Cover with wax disc and cellophane cover. Label with name and date. Store in a cool, dark place.

BILIMBI JAM

Ingredients	Quantities
Bilimbi	1 kg
Water	500 ml
Sugar	1 kg

Method

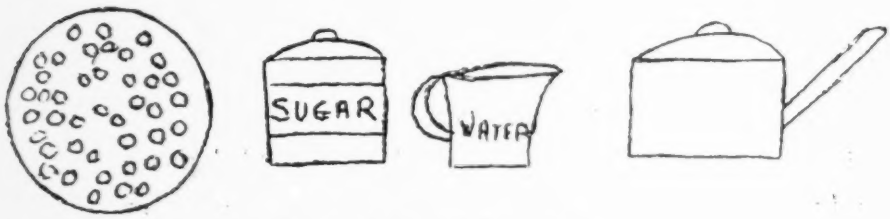
1 Wash and remove any damaged bilimbi and stalks.

2 Put water to boil. Blanch the bilimbi. Drain well.

3 Add sugar and bring to the boil. Stir and cook until jam consistency is obtained.

To obtain crystallised bilimbi

Drain the syrup and 'dry' the bilimbi in the sun. Use a food cover. Roll in granulated sugar and a pinch of chilli powder if desired.



BANANA AND LEMON JAM

Ingredients	Quantities
Bananas	1 kg
Sugar	850 g
Water	125 ml
Lemons (rind and juice)	2
Orange peel (finely chopped)	1

Method

1 Peel bananas, mash them with a fork.

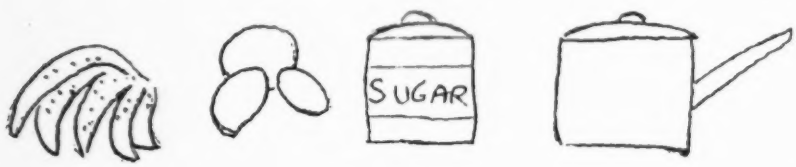
2 Make a caramel with the sugar and water.

3 Add mashed bananas, lemon rind and juice and finely chopped orange peel.

4 Bring to the boil, stir well and cook for 15-20 minutes until jam consistency is obtained.

5 This jam may be used as a filling for tarts and tartlets.

6 Put in hot sterilised jars. Seal well using ordinary lid.



MANGO JAM

Ingredients	Quantities
Mangoes (semi-ripe)	1½ kg (pulp)
Water	250 ml
Sugar	1½ kg
Vanilla	2 cm pod or ¼ t essence (optional)

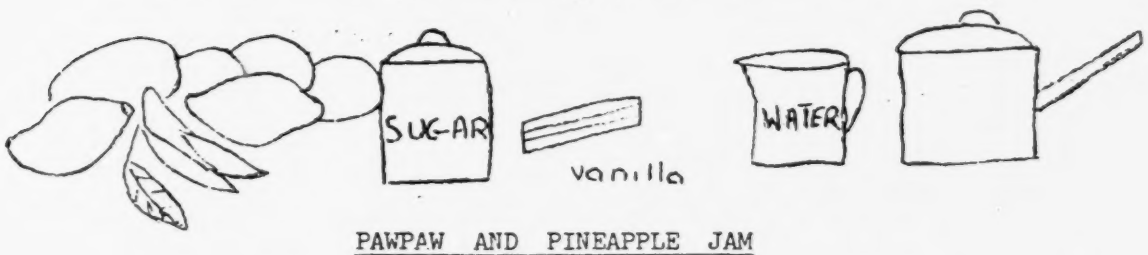
Method

1 Wash and peel and slice mangoes. Blanch.

2 Cook mangoes until soft. Drain well. Add sugar and vanilla.

3 Boil until setting point is reached.

4 Put in hot sterilised jars. Seal well.



PAWPAW AND PINEAPPLE JAM

Ingredients	Quantities
Pawpaw (semi-ripe)	1½ kg - 1 large
Pineapple	1½ kg - 2 small
Lemon	1
Sugar	2½ kg

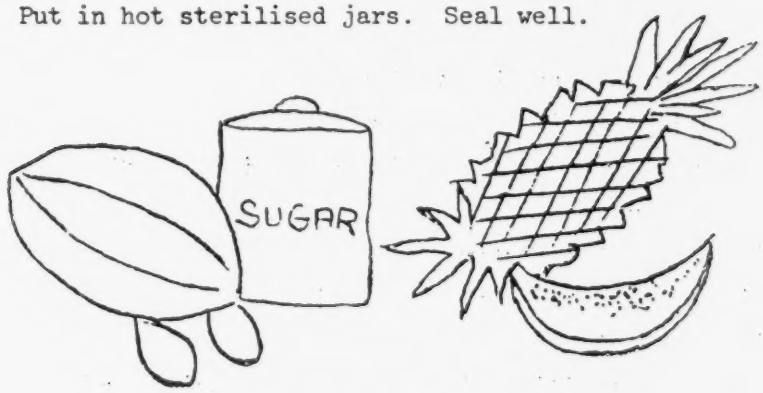
Method

1 Wash, peel and grate pawpaw and pine apple.

2 Add the sugar and lemon juice. Stir until dissolved.

3 Boil until thick and setting point is reached.

4 Put in hot sterilised jars. Seal well.



PAWPAW*/PUMPKIN AND LEMON JAM

Ingredients	Quantities
Pawpaw/pumpkin	1½ kg
Lemons	2 (grated rind and juice)
Orange peel	1 (finely chopped)
Sugar	1½ kg
Ginger	2 cm piece (optional)

Method

1 Wash, peel, slice and dice pumpkin or grate pawpaw.

2 Cook the pumpkin/pawpaw until tender.

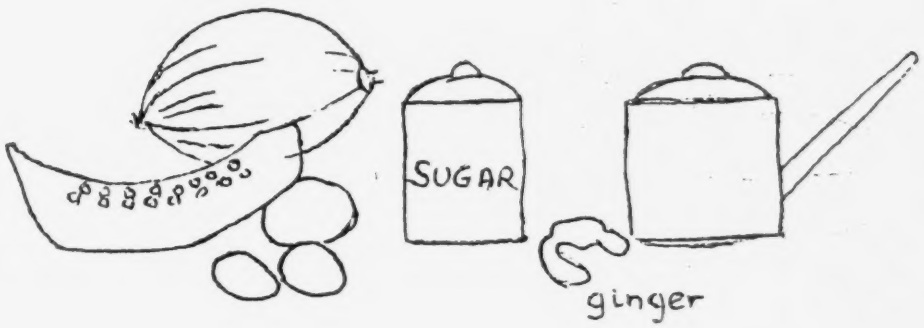
3 Add the grated lemon rind and juice, orange peel and ginger.

4 Bring to the boil, add the sugar. Stir and cook for 20 minutes or until thick.

5 The ginger should be removed before putting into jars.

6 Put in hot sterilised jars. Seal well.

* Use semi ripe pawpaw.



PAWPAW COMPOTE

Ingredients	Quantities
Pawpaw (semi ripe)	500 g
Sugar	400 g
Vanilla (optional)	4 cm stick

Method

1 Wash and peel pawpaw. Cut lengthwise in big slices. (About 6 slices). Blanch.

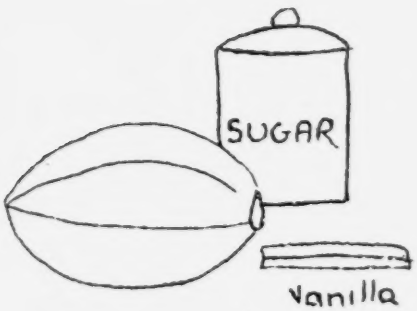
2 Put pawpaw in a saucepan. Pour sugar over it, add vanilla and cover the saucepan.

3 Cook over low heat until all the sugar has melted (about 3-5 minutes).

4 Remove the lid. Increase heat. Cook until syrup is thick.

5 Leave pawpaw in syrup and serve it with the syrup.

6 Put in hot sterilised jars. Seal well.



Variation

To keep pawpaw compote longer, add more sugar (600 g sugar to 500 g pawpaw) it makes a heavier syrup. After cooking, remove pawpaw slices and dry in the sun for a week. When dry, pour syrup over pawpaw, to make it spongy.

IMPORTANT POINTS TO REMEMBER IN JELLY-MAKING

1 The fruit should simmer gently and be thoroughly broken up before it is strained.

2 Strain the pulp without squeezing to obtain a clear jelly.

3 To get a well-set jelly pectin, acid and sugar should be present in the correct proportions.

4 The sugar should not be added to the strained juice until it has been brought to boiling point, and if it seems rather thin it is advisable to reduce further before adding the sugar. The heating of the juice and sugar together gives the jelly a deeper colour.

5 After adding the sugar, the jelly should be boiled rapidly until the setting point is reached. Then it should be skimmed, tested and poured into jars as quickly as possible.

6 Waxed circles should be placed on top of the jelly immediately, the jars are filled and the contents are still very hot.

7 Do not move the jars until the jelly has set.

8 Label the jars with name and date. Store in a dry, dark and well-ventilated place.

METHOD FOR MAKING JELLY

1 Choose and prepare the fruit as for jam, but skins, cores or stones need not be removed.

2 Simmer the fruit in the water or sometimes only in its own juice until it is very soft.

3 Mash it to a pulp with a wooden spoon.

4 Scald the jelly-cloth by dipping it in boiling water and draining it, then fix it in position with a large bowl below.

5 Pour the pulped fruit and juice into the jelly-bag and leave it until it stops dripping in 2 to 3 hours, or it may be left overnight.

6 The juice, or the mixture of juices, is tested for pectin and then measured.

7 For most jellies have the juice boiling and warm the sugar before adding it, but for a deeper colour add cold sugar to cold juice. Dissolve the sugar and boil and test the jelly for setting-point just as for jam.

8 All scum must be removed as it spoils the look of the clear jelly and the hot jars must be filled quickly before a skin can form on the jelly. The jars of jelly must not be moved before the jelly has cooled and set.

GOYAVE DE CHINE JELLY

Ingredients	Quantities
Goyave de Chine	1 kg
Water	500-700 ml
Sugar	allow 800 g to each litre of juice

Method

1 Wash and top goyave de chine. Place the fruit in a pan of water (500 ml).

2 Simmer until tender.

3 Mash well and strain through a sieve or a thin cloth.•

4 Measure the juice, bring to the boil, reduce as necessary.

5 Add the sugar (according to amount of juice).

6 Stir well and boil rapidly until setting point is reached.

7 Pour in hot sterilised jars. Seal well.

• You may remove the pulp and add 200 ml water, simmer again for about ½ hour and strain. The reason for boiling a second time is to increase the juice extract and make a more economical preserve: however, this is not essential. Mix the first and second extracts together, measure.

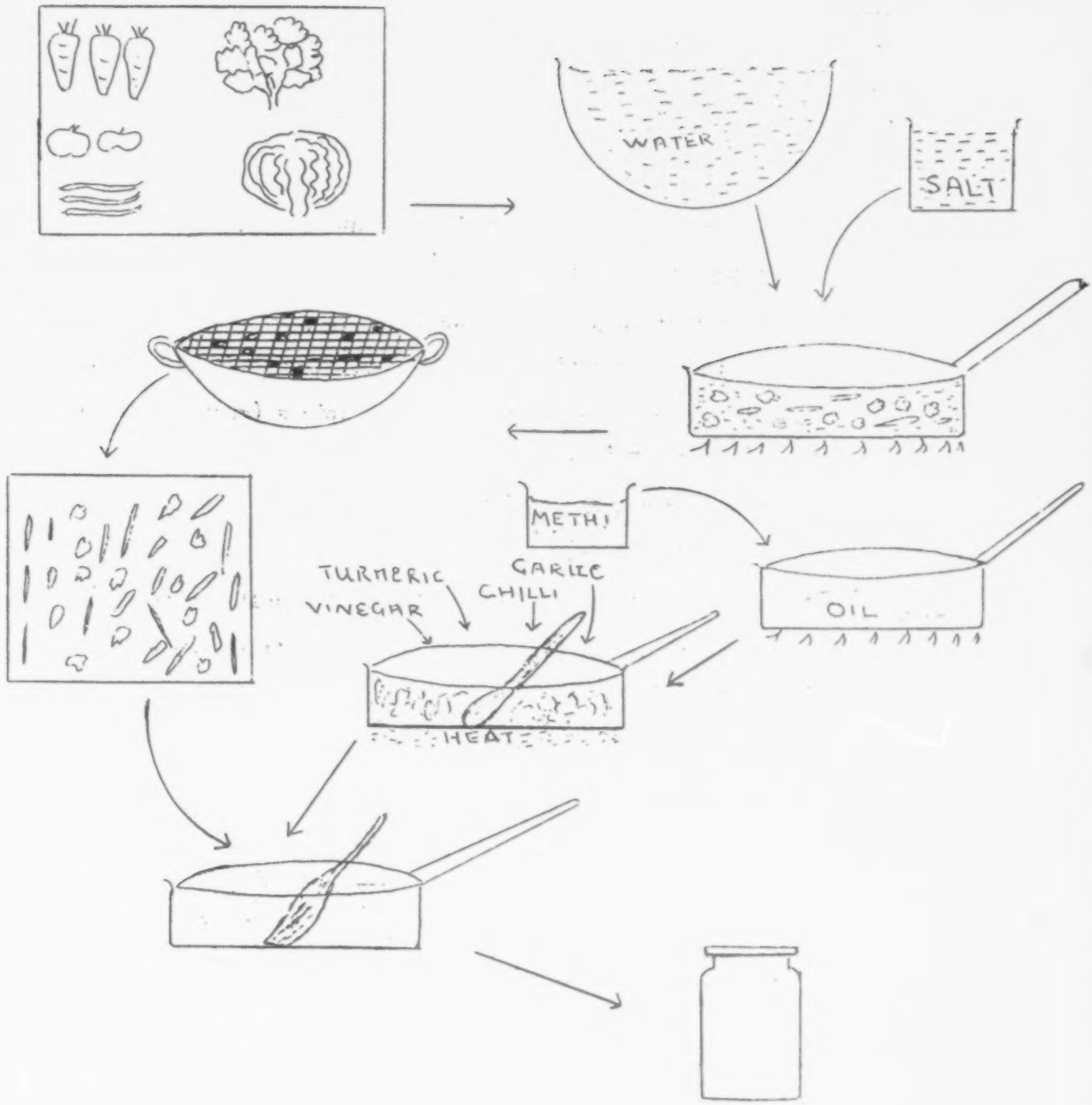
MIXED VEGETABLE PICKLE (Achards Légumes)

Ingredients	Quantities
Mixed vegetable	1 kg
Cooking salt	100 g
Green chillies (optional)	15
Methi (fenugreek seeds)	5 g
Chilli powder (optional)	50 g
Mustard	200 g
Turmeric powder	75 g
Garlic	100 g
Vinegar	200 ml
Oil	1 bottle
Water	2 litres

Method

1. Wash and cut a variety of vegetables into small pieces weighing 1 kg (e.g. cauliflower, beans, carrots).
2. Bring water to boil, then add 1 tablespoon of salt.
3. Put vegetables in boiling water for ½ to 1 minute.
4. Drain vegetables, place in a clean cloth.
5. Dry vegetables in the sun for 2-3 days.
6. Grind spices. Grind half mustard seeds.
7. Bring oil to smoking point, add methi, then cool, (add chillies - optional).
8. Add mustard powder, turmeric, chilli powder, garlic and vinegar; make a paste.
9. Heat all spices for 1 or 2 minutes over low heat.
10. Mix vegetables with the spices thoroughly.
11. Put vegetables in sterilised jar, cover with ordinary lid and put the jar in the sun for 2-3 days.
12. Add more oil to cover the vegetables and seal jar or use a light lid.
13. Store in a cool dry place.

MIXED VEGETABLE PICKLE



PICKLED BILIMBI

Ingredients	Quantities
Bilimbi	500 g
Salt	50 g
Turmeric powder	1-2 T
Mustard powder	100 g
Chilli powder (optional)	1-2 T
Garlic	50 g
Oil	½ bottle

Method

1 Wash and remove any damaged bilimbi, and stalk.

2 Cut bilimbi into 4 pieces. Remove seeds.

3 Spread bilimbi over a flat surface and dry in direct sunlight for 2-3 days (dry until the strips are tough and leathery).

4 Heat oil, leave to cool, then add all spices (mustard powder, turmeric and garlic).

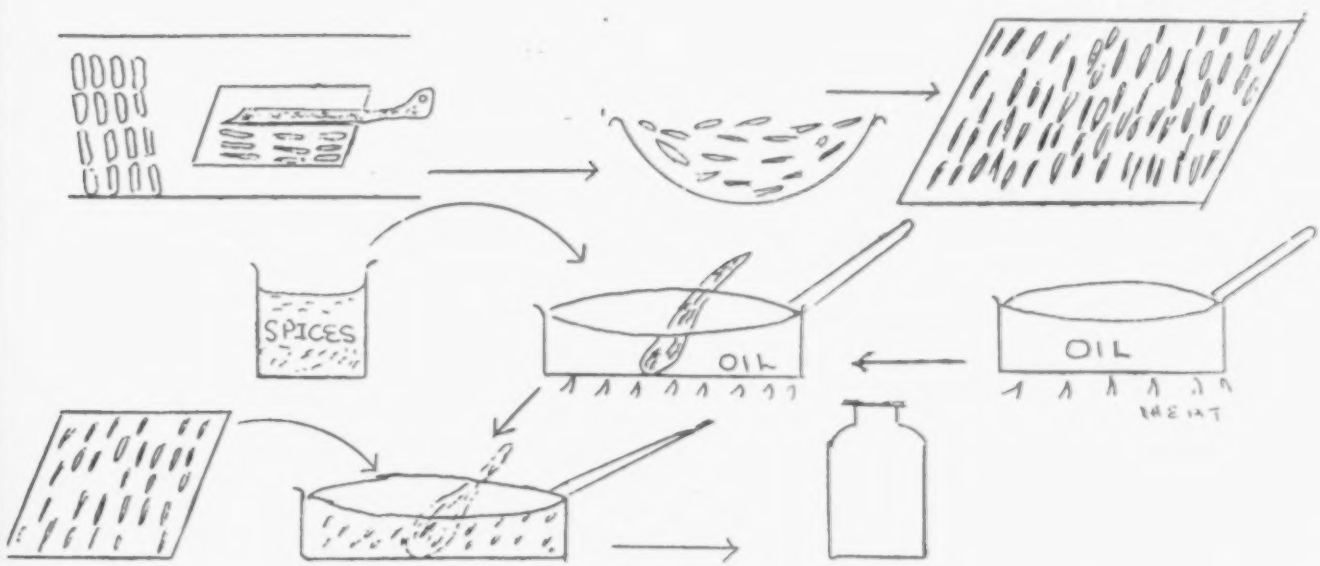
5 Heat all spices for 2-3 minutes.

6 Remove pan from heat, cool spices.

7 Then add bilimbi and mix with spices. Add salt (to taste).

8 Put pickle in clean, sterilised jars, add oil to cover pickle; seal jar.

9 Store in cool, dry place.



CHILLI SAUCE

Ingredients	Quantities
Small chillies	500 g
Vinegar	750 ml
Lemon (large)	3-4
Sugar	1 T
Salt	1 T
Oil	2 T
Garlic cloves	about 5

Method

1 Clean and wash chillies.

2 Clean lemon and cut up into small pieces.

3 Peel garlic cloves.

4 Crush chillies, lemon and garlic cloves on 'roche carri' or in mouli-chopper to a fine paste.

5 Heat oil in a deep pan.

6 Add chilli paste, vinegar, sugar and salt. Cook gently for about 30 minutes to a smooth sauce.

7 Allow to cool and pour in hot sterilised bottles. Seal well.

HOT CHILLI PASTE (MAZAVAROO)

Ingredients	Quantities
Red chillies	250 g
Vinegar	1 T
Salt	1 T
Garlic	75 g
Oil	2 T

Method

1 Wash chillies.

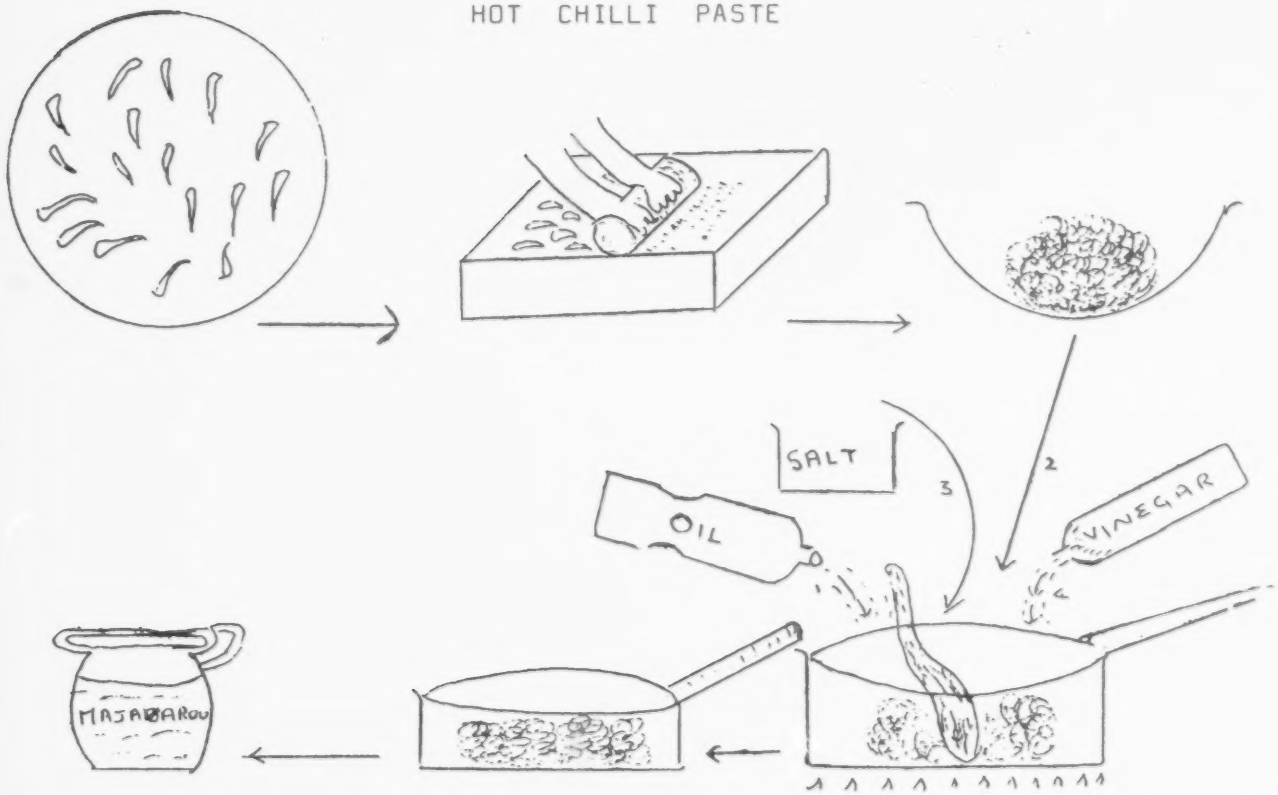
2 Grind chillies, garlic to a thick paste (do not add water) use vinegar. You can do it over 'roche-cari' or in an electric blender.

3 Heat oil, allow it to cool, then add chilli paste, salt and vinegar and cook gently over low heat for 10-15 minutes.

4 When cold, put in sterilised bottle and seal using ordinary lid.

5 Store in cool, dry place.

HOT CHILLI PASTE



PETITS PIMENTS CONFITS (CHILLI, BIRD'S EYES OR BIRD PEPPERS)

Ingredients	Quantities
Green chillies (petits piments)	250 g
Salt coarse	75 g
Water or vinegar (boiled, then cooled)	100-200 ml

Method

1 Remove stalk.

2 Wash chillies and dry. Then rub with salt and put in a clean, sterilised jar.

3 Close jar and leave aside for 3-4 days till all salt has dissolved.

4 Drain all water from jar.

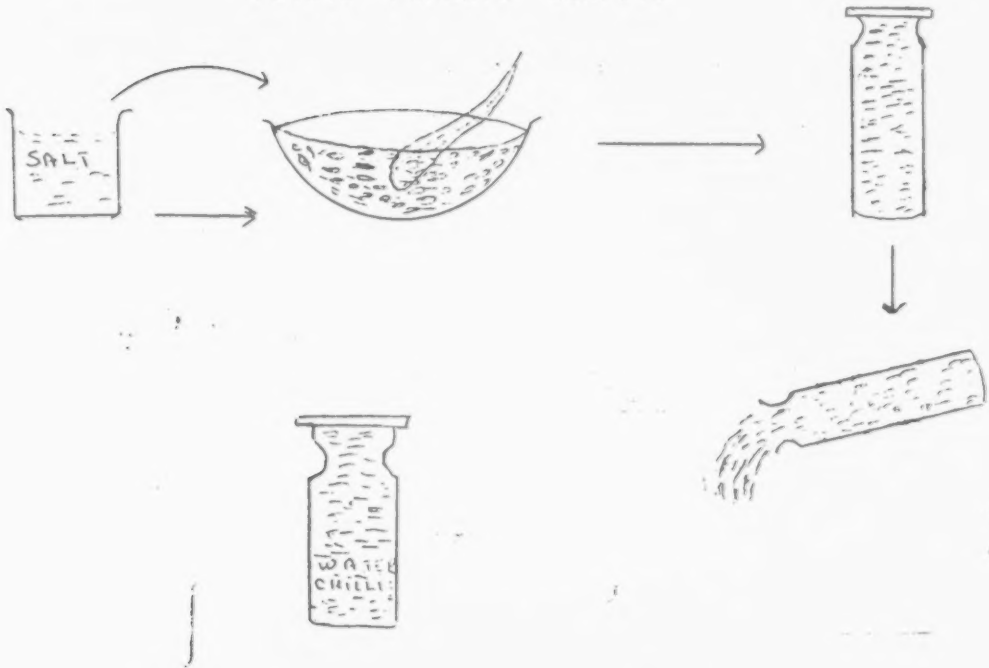
5 Then add fresh water or vinegar till the chillies are covered.

6 Close jar using a tight cork.

7 Keep in cool place. It can be kept for over a year.

8 Check jar regularly to make sure that chillies are always covered with water or vinegar.

PETITS PIMENTS CONFITS



PICKLED LEMON (LIMONS CONFITS)

Ingredients	Quantities
Lemons	25
Salt	100 g
Water (optional)	1¼ litres
Vinegar	250 ml

N.B. (Double the amount if only vinegar is used).

Method

1 Wash lemon.

2 Prick lemon using a fork or slit them lengthwise in quarters without cutting through lemon.

3 Bring 1 litre of water to boil.

4 Add lemon to boiling water for 3-5 minutes.

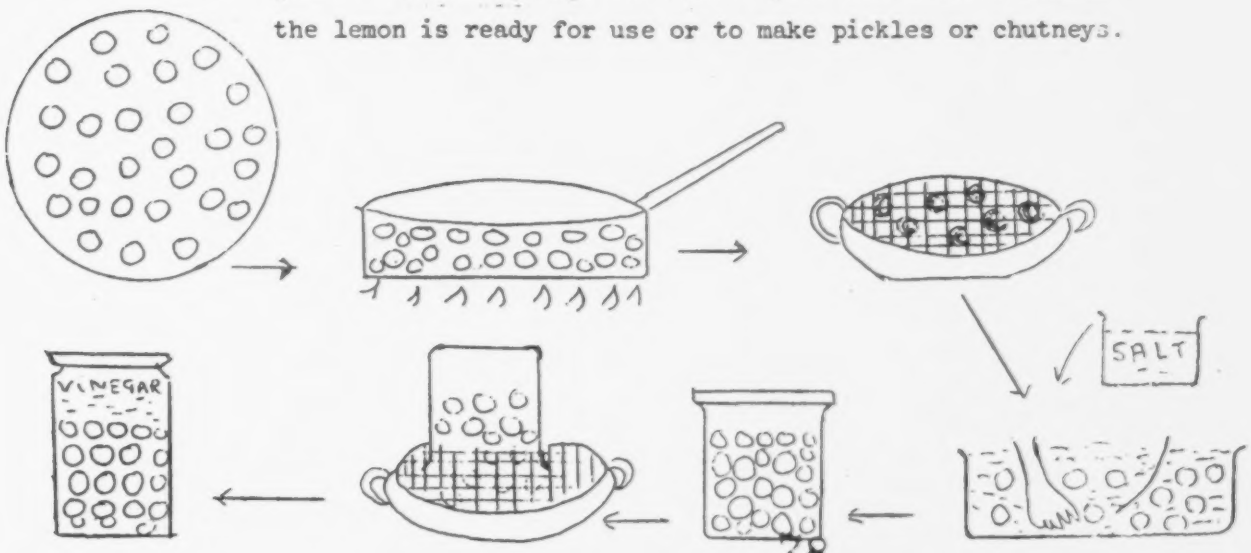
5 Remove lemon, leave to cool.

6 Rub lemon with salt and put in a sterilised jar.

7 Close jar and leave it to stand in the sun for 2-3 days till the salt has dissolved.

8 Drain all water from jar, then add equal amount of boiled, cooled vinegar and water in the jar. (The solution should be slightly above the lemon. Vinegar can be used only).

9 Cover jar tightly with ordinary lid and store in a cool place. It can be kept for over a year but after 3 months the lemon is ready for use or to make pickles or chutneys.



TAMARIND SYRUP

Ingredients	Quantities
Tamarind (shelled)	2 kg
Sugar	3 kg
Water	750 ml

Method

1 Boil the tamarind in the water for about 15 minutes to soften the pulp.

2 Allow to cool.

3 Pour the softened pulp in a fine sieve placed on a large pan.

4 Rub with a wooden spoon to squeeze out all the juice.

5 Add the sugar and simmer in an open pan until all the sugar is dissolved.

6 Boil gently to a fairly thick syrup.

7 Remove the scum.

8 Allow to cool.

9 Pour in hot sterilised bottles. Seal well.

TAMARIND PRESERVE

Ingredients	Quantities
Tamarind	500 g
Salt	2 T
Oil	2 T
Chilli powder (optional)	1 or 2 T

Method

1 Shell tamarind.

2 Heat oil and leave to cool.

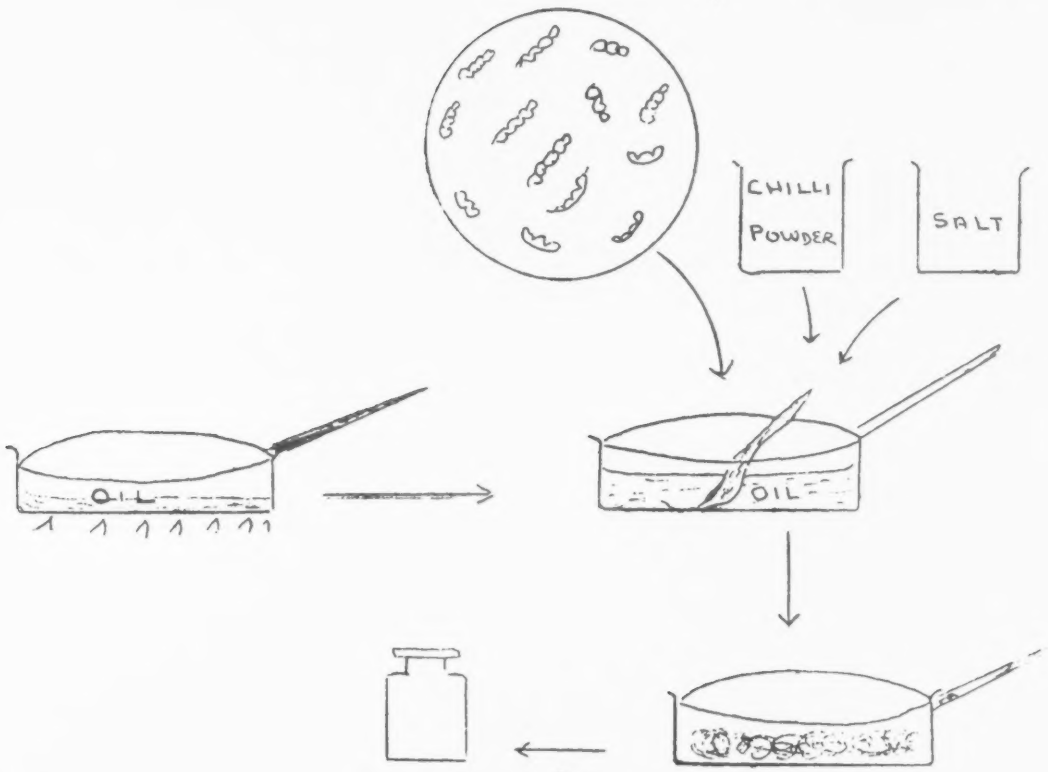
3 Put tamarind in the oil.

4 Then add salt, chilli powder and cook over low heat for 20-30 minutes, stirring all the time.

5 Cool and put in small clean sterilised jars, seal jars using ordinary lids.

6 Store in cool, dry place.

TAMARIND PRESERVE



TOMATO SAUCE

Ingredients	Quantities
Tomatoes	2½ kg
Vinegar	500 ml
Sugar	200 g
Salt	2 t
Cloves	5
Cinnamon sticks	2
Garlic (crushed)	1 t

Method

1 Wash the tomatoes.

2 Cook them until tender in half cup of water together with the sticks of cinnamon.

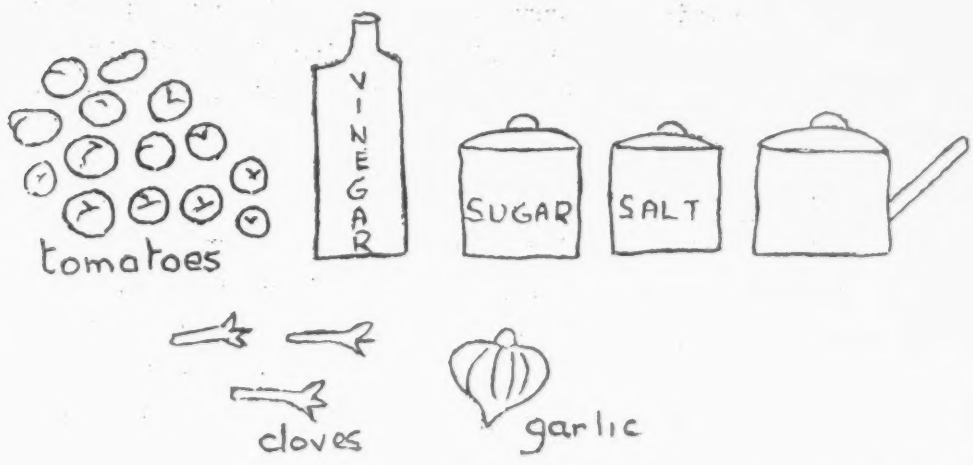
3 When cooked, rub the pulp through a sieve.

4 Add the salt, crushed garlic and the sugar, dissolved in the vinegar, to the sauce.

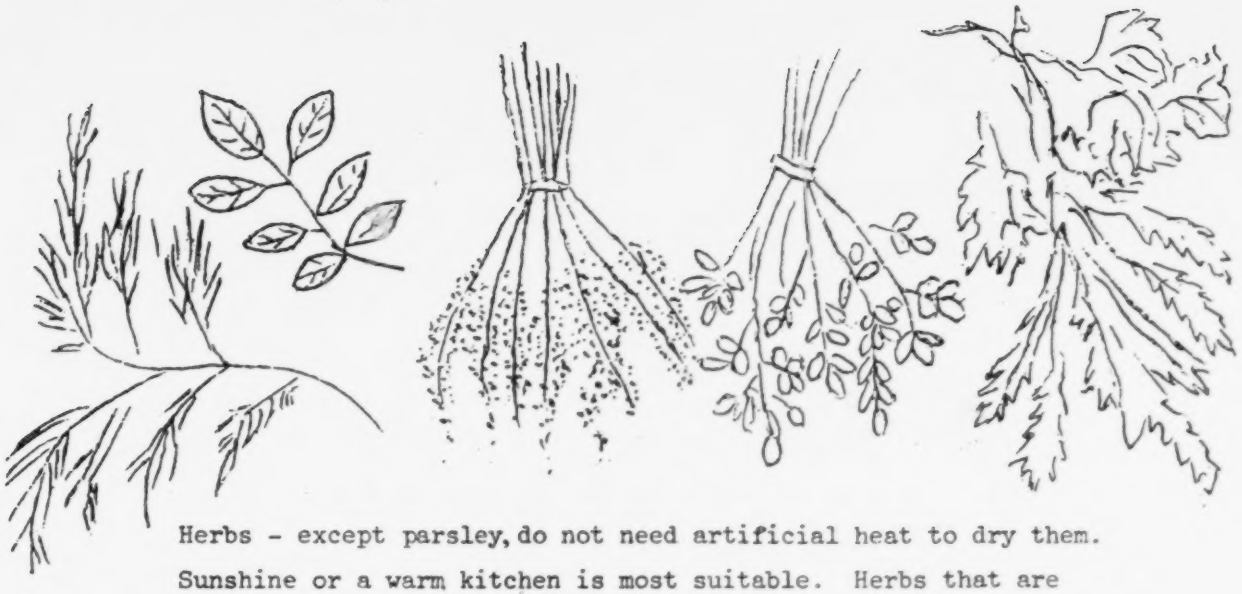
5 Boil gently in an open pan to a smooth cream of dropping consistency.

6 Allow to cool.

7 Pour in hot sterilised bottles. Seal well.



DRIED HERBS



Herbs - except parsley, do not need artificial heat to dry them. Sunshine or a warm kitchen is most suitable. Herbs that are mostly used for drying are thyme, mint, currypoulet leaves, quatre-épices leaves etc.

Method

1 Tie the herbs loosely in bunches, dip quickly in cold water.

2 Shake them and hang them to dry where the air can circulate round them. Protect the bunches of herb from dust by putting them in thin paper bags or muslin bags.

3 Strip the leaves from the stems when quite dry (with the exception of currypoulet leaves which are sometimes kept whole), crush them with a rolling pin as finely as possible.

4 Store each herb separately in air-tight tins or screw top jars.

Dried Parsley

Dried parsley is dried quickly to keep it green.

1 Wash bunches of parsley leaves in cold water.

2 Shake well and separate the leaves from the main stems.

3 Spread leaves on a wire tray and dry them in a fairly hot oven (375°F Gas Mark 5). Watching them carefully because the leaves brown quickly.

4 When the parsley leaves are crisp, crush them and store as for other herbs. Make sure that the parsley is quite cold before putting on the lids of tins or jars.

NOTE The parsley stalks should also be included as they have much flavour although they will not crush as finely as the leaves.

HERB VINEGAR

Herb flavoured vinegar is a good and simple way of introducing the flavour of herbs to various dishes e.g. sauces, salad dressings, soups. Mint or thyme are the herbs the most used in Mauritius because of their aromatic flavour but almost any herb or mixture of them can be used.

DRIED CHILLIES (PIMENTS SECS)

Ingredients	Quantities
Red chillies	500 g
Water	2 litres
Salt	1 t
Oil	1 T

Method

1 Wash and dry chillies.

2 Bring water to boil.

3 Add salt and oil to boiling water.

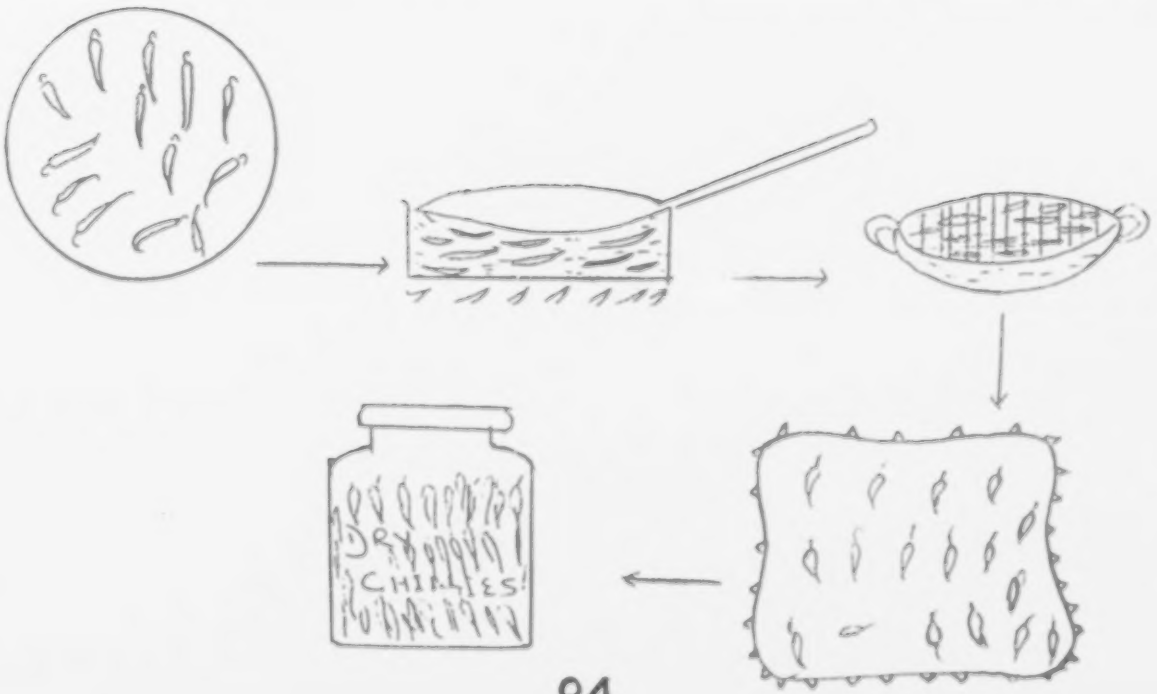
4 Put chillies in boiling water for 20-30 seconds.

5 Drain off water from chillies and spread them over clean cloth.

6 Dry chillies in direct sunlight.

7 Store dried chillies in a dry place. Red dried chillies can be powdered and stored in air-tight containers.

DRIED CHILLIES



MINT VINEGAR

Ingredients	Quantities
Vinegar	1 bottle
Mint	6 sprigs
Sugar	½ t

Method

1 Put vinegar in a saucepan and bring to the boil.

2 Wash mint, crush slightly 3 sprigs and put them into the vinegar. Add sugar. Stir well.

3 Remove the vinegar as soon as it reaches boiling point.

NOTE Vinegar evaporates quickly, but it should be sterilised before it is added to any vegetable substance otherwise it will turn sour.

4 Leave vinegar to cool.

5 Dry the remaining 3 sprigs of mint well, removing faded leaves. Put the sprigs in a bottle, strain the vinegar into it and cover with a screw top.

The mint flavour improves with keeping.

Garlic Vinegar

Slice 7 garlic cloves, add into 0.3 litre bottle vinegar. Leave for 24 hours and then remove them.

Vinegar from Seeds

Herbal vinegars from coriander, cumin or cardamom seeds have a spicy flavour.

Method

1 Bruise the seeds with a rolling pin.

2 Put in a jar and pour warmed vinegar over.

3 Cover the jar and put in a warm place for 15 days.

4 Shake the jar from time to time.

5 Strain. Bottle tightly.

Herbal Oils

Herbs e.g. thyme or mint, add special flavour to cooking oil. Make them by simply steeping the herb in the oil. Place the bottle on a sunny shelf.

SOME FAULTS IN FRUIT AND VEGETABLE PRESERVATION

Fault	Cause
Fruit Bottling	
Poor colour of fruit	Fruit over-ripe or underripe Slow preparation Poor processing method Fruit over-processed Failure to store bottled fruit in a dark, cool place.
Discoloration of fruit at top of jar	Poor delayed preparation, e.g., bananas Fruit not covered by liquid Jars not covered with water in water bath Fruit under-processed.
Fruit risen in jar	Over-ripe fruit Failure to pack tightly Over-processed or too rapidly processed (Fruit is more likely to rise when packed in syrup than when water is used.
Cloudy fluid	Fruit over-ripe Fruit dirty Syrup not strained before use Fruit over-processed.
Air bubbles in jar	Fruit packed too tightly Failure to shake out bubbles when filling bottle with liquid (With soft fruit, when the method permits, it is advisable to add liquid while packing Bubbles often disperse on storage.
Jams and Jellies	
Syrupy consistency	Over-ripe fruit Too short or too long boiling after addition of sugar Unbalanced recipe Inaccurate weighing.
Mould on surface	Wet or inferior fruit Poor recipe Yield too large Poor set Unsuitable cover Cover incorrectly used Jar not filled with preserve Warm or damp store.
Crystallization	Wrong proportion of acid Overboiling or underboiling.

Fault	Cause
Coffee sugar crystals	Underboiling. Too little acid.
Needle crystals or a solid mass	Overboiling. Too much acid. Fruit or extract not sufficiently reduced before adding sugar.
Preserve shrunken	Poor covering Warm storage.
Air bubbles throughout	Poured into jars too slowly (especially with jelly) Allowed to cool too much before potting.
Cloudy jelly	Dirty fruit Jelly bag mesh not sufficiently closed Jelly bag squeezed to hasten process.
Fruit Syrups	
Sediment in bottle after storage	This occurs naturally when fruit has not been through a fine strainer. It is not a fault unless excessive in quantity.
Pickles	
Shrinkage in jar after short storage	Unsuitable cover. Paper covers and jam covers are not sufficient to prevent evaporation of vinegar.
Cloudy fluid in pickles	Insufficient brining of vegetables Poor quality of ground spices used Spices not completely strained from substance.
Sauces	
Separation of vinegar from sauce	Undercooking In ripe tomato sauce, over-ripe tomatoes or delay in preparation may give separation.
Dark colour in ripe tomato sauce	Brown vinegar used instead of white Brown sugar used instead of white Poor colour tomatoes Overcooking with sugar Light or warm storage.
Dried Fruit, Vegetables and Herbs	
Herbs lacking flavour	Old when gathered Poor method of preparation
Herbs poor in colour	Old when gathered Overheated.

ACTIVITY I

How some foods can go bad in the tropics

Action of enzymes in a variety of local foods

e.g. banana, bilimbi, tomato, pawpaw, pineapple.

1 Leave 2 of the above-mentioned food cut slightly or cut into slices exposed to air.

2 Observe the changes after two days, after a week.

3 Describe orally what changes have happened.

4 Discuss the changes e.g. browning of cut surfaces because of enzymes.

ACTIVITY II

Food handling - Food hygiene

Make up a stiff jelly using agar-agar (la mousse). Pour the liquid jelly into saucers and cover at once. Why, When the jelly has set, uncover one dish at a time and try the following:

1 Touch the jelly with (a) clean finger
(b) unwashed finger after visiting W.C.

2 Put some human hairs on the jelly.

3 Cough upon the jelly.

4 Leave one untouched and covered.
(Leave 3-4 days).

Examine the dishes. Write down what you find and your conclusions.

Other Suggested Activities

1 Proving how quickly some foods can go bad in tropical atmospheres - checking by groups for a feasible variety of local foods.

2 Encouragement to describe what has taken place - written oral and discussion afterwards.

3 Suitable thermometers or from radio broadcasts on weathe...

(a) a knowledge of the daily temperature.
(b) a knowledge of the daily moisture content.
(c) what these do to dry foods, cloth materials, evaporation from the skin.

4 If at all possible, try to see micro-organisms, a micro cope may be used, if possible.

- finger prints)
- human hairs) on glass or saucers wi... the atmosphere will make
- cough or sneeze expectorant) them multiply.
- used tea towel)

5 Practice in - bottling fruit or chutneys
- sealing jars or bottles with fat or wax
- Science, forming a vacuum.

6 Testing foods to see how they are keeping.

7 Visits to canning/bottling factories whenever possible.

8 Preservation of certain foodstuffs for cyclonic season. Which foods? Why? How are they good at such a time as a cyclone? What is their food value?

9 Group activities to have as wide a variety of ways used e.g. salting, drying, smoking, using sugar etc. Group checking how long food stays in good preserved condition.

EQUIPMENT AND TOOLS

Garden Tools

Gardening cannot be done correctly unless proper tools are available. Different tools are required for the kitchen garden for various operations. A beginner needs a few basic tools to start with, but over the years he may have a good range of tools. The tools should not necessarily be expensive ones. They should be appropriate, lasting and cheap. Some tools and their functions are described below.

The Garden Fork

The fork is used for breaking and loosening the soil. Two sizes and types of forks are available. Forks should neither be too light nor too heavy. The right one should suit the cultivator's capacity. However, a light fork demands more effort than a heavy one. The cultivator will find it easier to break the soil if he wears boots.

The Hoe

It is the most commonly used garden tool in Mauritius. It is used for the following operations :

1. Weeding
2. Digging pockets
3. Making irrigation furrows/channels
4. Ridging and earthing up.

The Rake

It is used for levelling surface soil while preparing seedbeds. It is very useful in removing surface rubbish and small stones. The rake should be fitted with a strong handle but the latter should not be heavy. A good rake makes the work less laborious.

Hand Fork

It is used for surface cultivation. Such operations as weeding, breaking up lumps, loosening the soil, mixing of fertilizers with the top-soil are performed with the hand fork.

Trowel

It is used for transplanting vegetable seedlings and for planting rooted cuttings in beds and on ridges.

Watering Can

It is a very essential garden tool. It is used to water seedlings and young plants in beds and boxes. Watering cans are available in various sizes. It is preferable to have one which can be comfortably carried when it is full (i.e. 10-12 litres capacity). One should be fitted with a fine hose for watering freshly-sown seeds and seedlings.

Rattan Basket

A rattan basket is essential in a garden for carrying materials such as manure, compost, soil, seedlings, weeds and trash. The basket should hold at least 10 kg of compost when full.

Garden Line

A garden line can be a rope (Coconut coir) or a string. It is essential in the initial layout of the garden and is used in lining beds and demarking boundaries in seed-bed preparation.

Peg

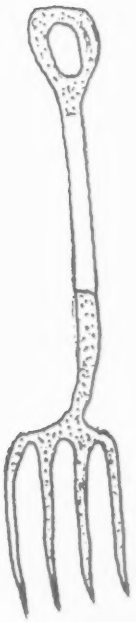
Wooden pegs can be cut and made from branches of trees or from planks. A peg should be 30 cm long and pointed at one end. It should not split when hammered into the soil.

Garden Knife

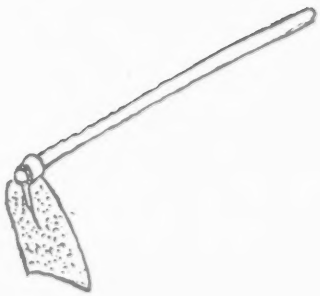
It is essential for cutting plant material. It should be very sharp.

Maintenance of tools

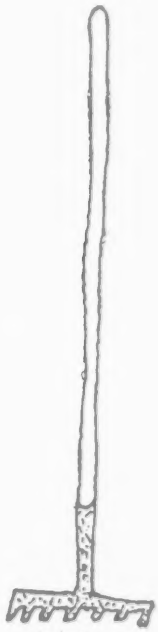
All garden tools must be cleaned after use. Any soil or caking on tools must be removed before washing. The metal parts may be dabbed with an oily piece of rag. Tools must be kept in a dry place. Rattan baskets must be washed and allowed to dry up.



The Garden Fork



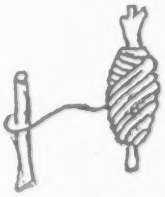
The Hoe



The Rake

Hand Fork

Trowel



Garden Line

Rattan Basket

Peg

Garden Knife

Watering-can

Fencing

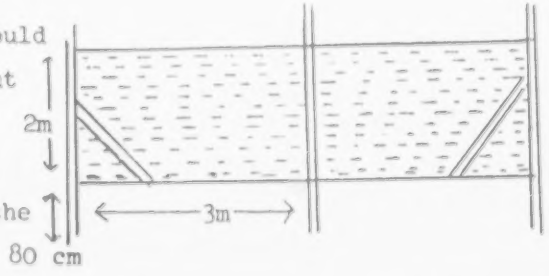
When setting up a kitchen-garden, it is extremely important to put up a strong fence around the garden which will keep out chicken, dogs, goats and possibly thieves. It is useless to start the garden unless this is done.

A fence may be built of imported or local materials depending upon the funds which are available. Fences made of imported materials may be stronger and may last longer than those made of local materials but they are quite expensive. A fence made of local materials is normally cheap and may be quite effective if built properly. The following local materials may be used for the construction of a fence: bamboo poles, aloe leaves or stems, sugar-cane straw, wooden poles, coconut leaves, vetiver leaves etc.

A fence may also be made of living plants. Such fences, however need regular trimmings and occupy more space than non-living fences, since the strip of land along the fence should be left uncultivated. Plants that make good fences are bamboo, filao and acalypha. Spiny plants such as bread and cheese and certain cactuses are particularly effective against animal intruders.

Although the main function of the fence is to keep out stray animals, it may also be made productive. Certain creeping plants grow perfectly well on fences. Plants like bittergourd, broad bean, winged bean, grenadille, chouchou etc. will contribute to the production of the garden when made to grow on the fence. It should be noted, however that a weak fence on which a creeping plant is growing is very likely to be damaged during cyclonic weather.

To obtain a good fence, strong poles (either wood or metal) should be placed deep in the soil (about 60-80 cm deep) at intervals of about 3 metres from each other. Poles placed at the corners of the



garden should be strongly supported by props. The fencing material (e.g wire netting straw etc.) should then be fixed to the fence structure as uniformly as possible.

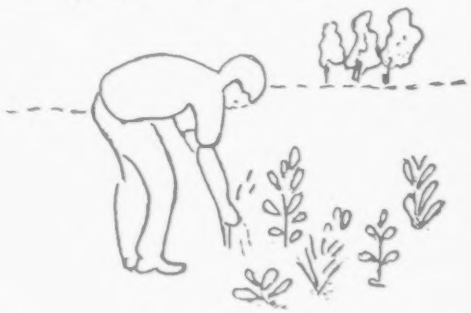
For living fences a trench about 60 cm wide and about 50 cm deep should be dug. The planting materials (e.g seeds seedlings or cuttings) should be planted at regular intervals along the trench. The plants should be cared for regularly till they reach the trimming stage.

Soil Preparation

The soil is a provider of mineral salts and water. It also provides the roots with air to allow them to breathe; it supports the plant. To allow the soil to fulfil all these functions properly it should be carefully prepared.

Before sowing seeds, the soil should be well dug and properly broken down. This is accomplished with the use of the garden fork, the hoe and the rake.

The following steps should be followed when preparing the land for planting.



Step I Land clearing

Cut down trees and bushes. Remove tall weeds and large stones.

Step II: Forking

Using a garden-fork, fork the land to a depth of 30 cm to loosen the soil.

During the forking operation one should move in a backward direction.

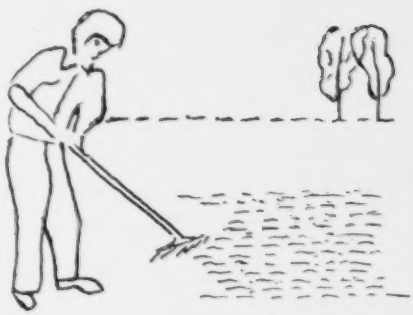
Step III Hoeing

Dig the soil a small area at a time using the hoe. During this operation break the large clods and remove the weeds, roots and loose stones. Have a ratten basket ready by your side to collect the weeds and stones.

During this operation one should move forward.

Step IV Levelling

The land should be levelled using a rake. A levelled land makes further operations easier to perform



After the land has been prepared, it may be used for the following purposes:

(1) Raising seed-beds for seedling production

(2) Raising seed-beds for direct sowing

(3) Direct sowing or transplanting in holes, drills or mounds.

Raising of Seedbeds

After the land has been thoroughly prepared, seed-beds may be raised. Seed beds are raised in two different ways depending upon whether they are to be used for seedling production, for transplanting or direct sowing.

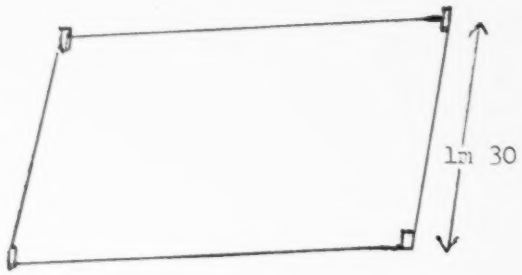
Seedbed Preparation for Seedling Production

For seedling production seed-beds should be raised with much care. The soil should be worked to a fine tilth and carefully levelled.

The following steps should be followed to raise the seed-bed.

Step I

The plot of land where the seed-bed is to be raised should be carefully marked with the help of pegs and rope.



Note: The width of the bed should be about 1 metre to facilitate watering and weeding operations but the length may vary. The pegs should be placed 1 mt 30 cm apart along the width to make allowance for a path of 30 cm between each pair of beds.

Step II

Spread as uniformly as possible the farmyard manure over the marked area. Repeat the same operation using the fertilisers. If the soil is too clayey or heavy, sand may be added.

A seed-bed of size 4½m long 1 m wide (area 4½ sq.m) will need the following:

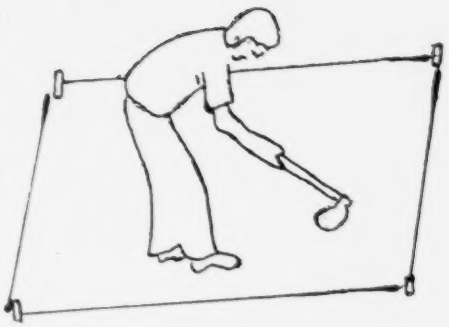
2 baskets of Farmyard manure
125 gm of sulphate of Ammonia

65 gm of triple superphosphate
65 gm of muriate of potash
1 basket of sand (if necessary)

Step III

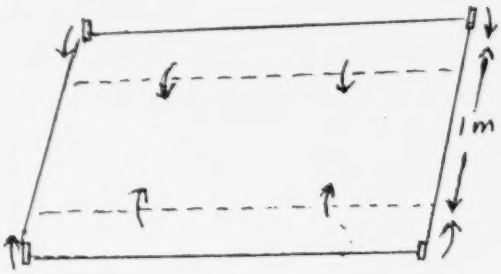
Using a hoe thoroughly mix the soil, the manure and the fertilisers over the marked area.

During this operation one should move in a forward direction.



Step IV

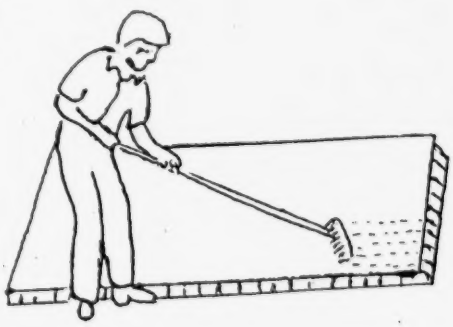
Remove the pegs at the four corners of the plot and place them again in the soil such that they are 1 metre apart as shown in the diagram. Now, using the hoe, transfer the topsoil from the two adjacent strips on to the seed-bed. This operation will raise the height of the seed-bed by 10 - 15 cm while leaving a path of about 30 cm wide between each pair of beds.



Step V

Consolidate the sides of the bed (if necessary) using a plank. With a rake, level the surface of the seed-bed carefully to obtain a flat surface.

The bed is now ready for the production of seedlings.



Sowing Methods

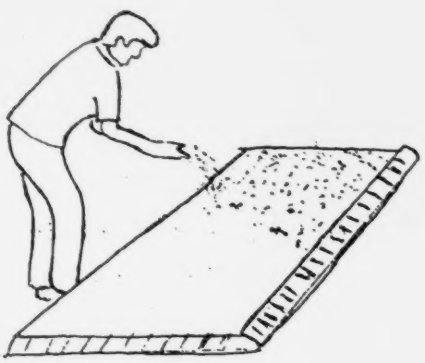
There are three main methods of sowing seeds in the garden namely:

(a) Broadcasting
(b) Sowing in drills
(c) Sowing in hole or furrows

For the production of seedlings the two first methods are commonly used. The third method is used for crops that need not be transplanted e.g beans, peas, etc.

(a) Broadcasting

In this method, the seeds are spread as uniformly as possible on the surface of the seed-bed. Using a soil sieve, a thin layer of fine soil is then spread over the seeds. This method is commonly used by local planters because it is simple and easy to perform.



Broadcasting

(b) Sowing in Drills

Parallel V shaped furrows about 1 - 3 cm deep and 10 - 25 cm apart are made across the bed using a pencil-size stick. The seeds are dropped at regular intervals in the furrows and then covered with a thin layer of soil.

Sowing in drills

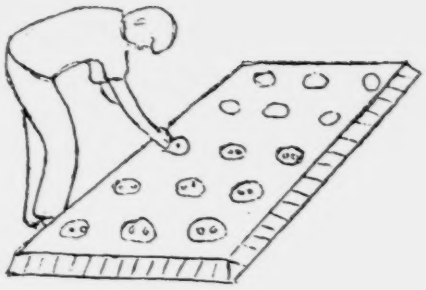
This method of sowing has the following advantages.

It facilitates:

(1) the weeding of the plot
(2) the application of fertilizers
(3) the control of pests and diseases.

(c) Sowing in holes

Seeds are sown in holes made at regular intervals on the seed-bed. This method is suitable for crops that will not be transplanted.



Sowing in holes

Raising of Seed-beds for Direct Sowing or Transplanting

For direct sowing or transplanting the seed-beds are raised following the steps described previously except for Steps II and III. That is, no fertiliser or manure should be added to the soil before raising the seed-bed. Such a seed-bed is used for the direct sowing of crops like beans/garlic or for transplanting seedlings like those of lettuce or beetroot.

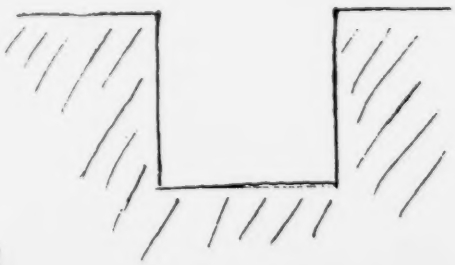
Transplanting

For many vegetables the seeds are sown on seed-beds and when the seedlings reach three to four leaf-stage they are transplanted on to other seed-beds or directly in the field. Crops such as cabbage, lettuce, cauliflower, beetroot, chillies and bringelle are normally transplanted.

The following steps should be followed for transplanting:

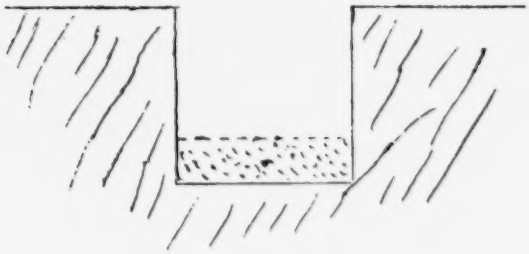
Step I

Dig a hole of the required size in the soil using a hoe.



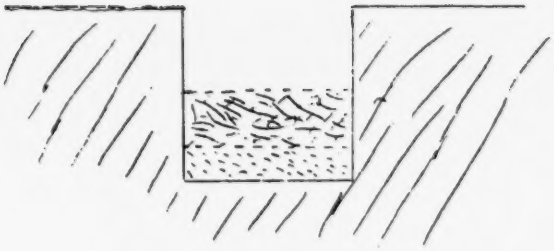
Step II

Place the required type and amount of fertilizers at the bottom of the hole



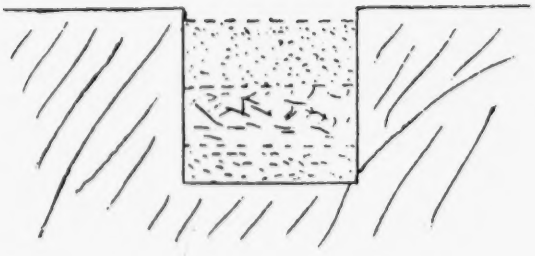
Step III

Cover the fertilizers with some farmyard manure.



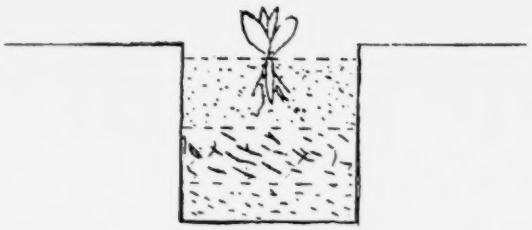
Step IV

Cover the manure with a layer of soil



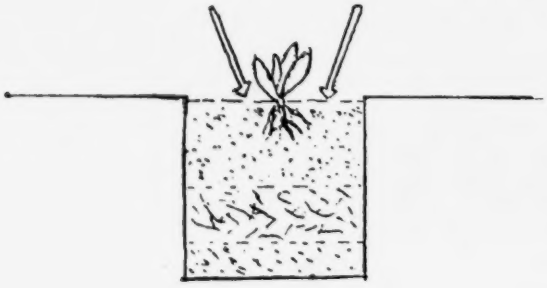
Step V

Transplant the seedling at the centre of the hole.



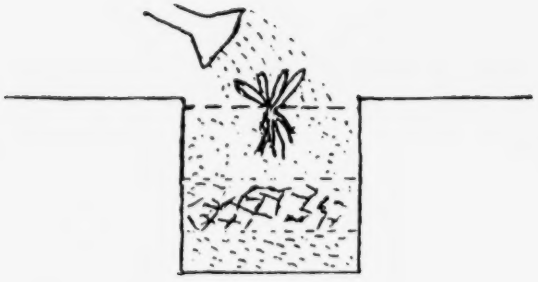
Step VI

Press the soil lightly around the base of the seedling.



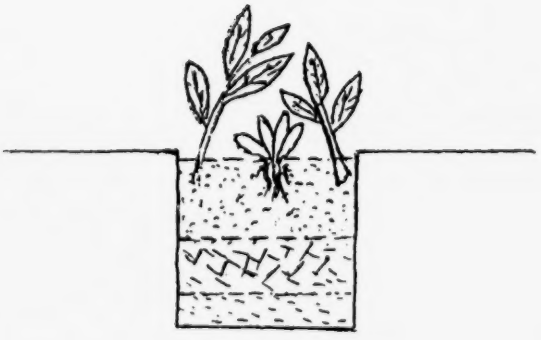
Step VII

Water the seedling copiously



Step VIII

Shade the seedling using small branches and leaves.



The following points should be considered when transplanting seedlings:

(i) Seedlings which are removed with some soil around the roots have a better chance to survive and to grow properly than bare-rooted seedlings.

(ii) Water the seed-bed a few hour before removing the seedling.

(iii) Transplanting done late during the day allows the seedlings a better chance to recuperate.

(iv) Seedlings should be transplanted as soon as possible after they have been up-rooted. Otherwise they should be kept under cool and moist conditions.

WATERING

Water is needed by plants for the following reasons:

(1) Germination
(2) Growth and development to take place in plants
(3) The uptake of nutrients (plant food) from the soil, through the roots, to other parts of the plant
(4) Flowering and fruiting to occur
(5) The prevention of wilting (drooping of leaves) to take place in plants.

Therefore, plants need regular watering to grow well and produce good crops. During rainy seasons plants require less frequent waterings. While those grown during dry seasons require comparatively more water. Crops grown in a sandy (light) soil will require more frequent watering than those in a clayey (heavy) soil. Generally crops with large root system require more water.

Vegetable crops are normally watered with a large-rose watering can so that the soil is moistened properly. A fin-rose watering can is used for watering seedlings because the fine water drops:

(1) do not wash away the soil particles

(2) soak into the soil easily and gradually

(3) do not damage small plants and seedlings.

Heavy water drops, from a large-rose watering-can compact the soil and a hard surface layer is formed. This hard layer prevents the water to soak into the soil and the water runs off and becomes unavailable to the crop.

Seedlings must be watered early in the morning and evening. If crops are watered during the day care should be taken so that water is applied to the soil and not to leaves. Vegetables can also be watered with a garden-hose.

Watering frequency can be determined by the amount of water present in the soil. This can be tested by pushing a finger in the soil to depth of 7 cm . If the soil is moist do not water but if it is dry water with a fine-rose watering can or garden hose. Watering should be done with a fine-rose till the soil is completely wet. As soon as seeds start to germinate and until they become seedlings, watering should be copious and regular. Watering frequency should be increased as the plants grow. If water is applied insufficiently it will moisten only the top soil and roots will grow superficially. To prevent this from happening it is preferable to irrigate less frequently but copiously each time to soak the soil. This will facilitate the roots to penetrate deep into the soil.

The effects of watering can be improved in the following ways:

(1) Add organic matter (compost or manure) to the soil. This absorbs and retains water.

(2) Hoe the soil. Hoeing breaks and disturbs the surface soil and reduces loss of water through evaporation.

(3) Put mulches on the soil during dry season as they conserve soil moisture.

MULCHING

Mulching is the spreading of a layer of dead organic matter on the soil and around plants during dry season mainly to prevent the excessive evaporation of water from the soil.

Mulching has many beneficial effects on the soil and these are:

(1) It conserves moisture.

(2) It controls soil erosion by providing a cover on the soil and protects the soil from beating rain.

(3) It keeps down the growth of weeds by keeping out light from the soil.

(4) It prevents the formation of a hard crust on the surface of the top soil.

(5) It stabilises soil temperature. In winter mulches keep soil warm and in summer cool.

(6) It increases the fertility of a soil by adding nutrients into the soil while the organic mulch decomposes.

(7) It acts as a cushion against heavy rains and young seedlings are not damaged by the splashing soil practicles on their leaves.

(8) It makes a heavy soil friable by incorporating organic matter into it.

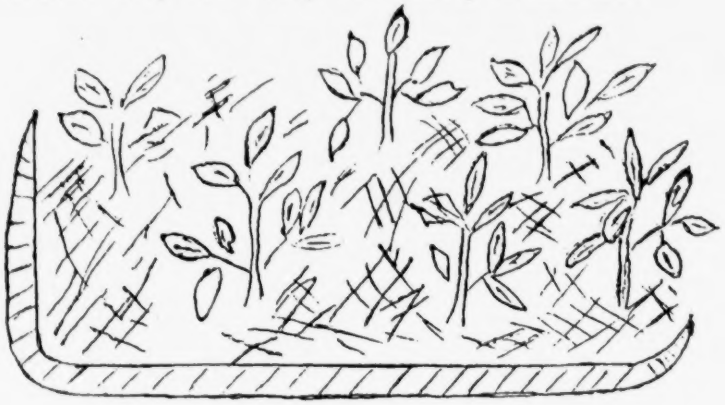
(9) It encourages an increase in the population of worms which are good soil conditioners.

Mulching may be done with any of the following materials:

1. Sugar cane straw
2. Bagasse
3. Grass
4. Leaves

5. Sawdust
6. Wood chippings
7. Rice husk
8. Ground nut hulls
9. Maize stalks or leaves
10. Compost
11. Manure

Any type of easily available vegetation without ripe seeds which is not diseased and does not contain too much water may be used for mulching. Plastic sheets may also be used provided they are cheap and easily available.



Some vegetables that may be mulched are.

1. Cabbage
2. Lettuce
3. Cauliflower
4. Chilli
5. Tomato
6. Beet root
7. Gourds
8. Cucumber
9. Melon
10. Water melon

Mulching is practised extensively in the cultivation of strawberry for the various reasons mentioned above.

COMPOST

Compost consists of a mixture of decaying plant refuse animal waste and soil.

Compost rots and decomposes and turns into humus, a black substance rich in plant food. Therefore compost is very important in the soil for crop cultivation.

Some of the functions of compost are

(1) It holds water and makes it available to the roots of plants.

(2) It helps in the formation of soil granules. Hence it improves the soil and makes it convenient for root development and plant growth.

(3) When compost decomposes it releases minerals which become available to plants.

(4) It holds nutrients in the soil to be used by plants.

(5) It protects the soil from beating rain and checks the washing away of soil particles which it binds together.

(6) It serves as food for microbes which in turn release minerals for plants.

(7) During the decomposition of compost heat is produced. This heat raises the temperature of the soil. Therefore during winter the soil becomes warmer and plant-roots grow well.

COMPOST MAKING

Compost is made by allowing organic matter, both from dead animal and plant parts, to decay in a pit or heap through a natural process with the help of microbes in the presence of moisture and air. Usually heat is generated as a result of decomposition of the materials. This process turns fresh

plant material into dark-brown crumbly and friable compost. Compost does not at all look like the original materials used in its making.

Compost can be made in a pit in places where rainfall is low or in a heap in rainy areas.

Materials required:

1. Kitchen waste like fruit and vegetable-peels tea leaves, egg shells, fish wastes and any soft vegetable matter. Any other organic matter such as freshly cut lawn grass, leaves, weeds without seeds, wood chippings, maize stalks, sugar cane leaves or straw.

2. Dung from any of the following animals; goat, cattle, rabbit pig and horse and poultry dropping.

3. Garden soil.

4. Wood ash.

5. Cattle urine (if available) or ammonium sulphate.

6. Wooden stakes.

Care should be taken not to include hard wood-stuffs such as rose prunings and bamboo hedge trimmings. Never use leaves of conifers such as Pine and Arocaria as they do not rot easily. The soft vegetables and fruits are the first to decompose and decay and are therefore called "starters".

Step I

Dig a pit on a level ground of any dimension in a corner of the garden. A suitable dimension would be:

Length: 1 m 20
Width : 1 m 20
Height: 1 m 20

Step II

Place a layer of roughages or vegetable matter such as chopped sugar cane straw, maize stalks grasses or leaves in the pit. Press with foot. This layer should be about 20 cm thick.

Step III

On this layer spread a 2.5 cm layer of manure and/or animal dung. Spread a thin layer of wood ash and garden soil on the manure. Sprinkle a little water.

Step IV

Repeat these alternate layers till the pit is filled. It may not be possible to fill the pit in one day therefore, this process may have to be repeated several times before the pit is filled.

Step V

When the pit is filled, place a layer of grass on top of the pit and cover this grass with a thin layer of soil. Push a few stakes into the material. These will be used for testing the temperature of the compost heap and for its aeration.

Step VI

Make a ridge with soil along the sides of the pit. This will prevent rain water to fill the pit. The preparation of the compost pit is then completed.

After about three months the compost should be ready for use. If it is not ready the compost should be turned over into the pit and sealed with soil and left for 2 - 3 weeks. Good compost has a sweet earthly smell.

Care should be taken to keep the compost hot enough as a reasonably high temperature is required for the material to decay. The suitable temperature should be bearable when a stake is touched as soon as it is removed from the pit. A rise in temperature is good as it indicates that the

microorganisms are active and that decomposition is occuring.

The pit should not contain too much water. It should be moist but not soggy. If it is too wet remove the stakes. These will leave holes in the compost and allow air to circulate. The moisture will be reduced through evaporation. The time the material will take to decay depends on the following

(1) The type of vegetable material used.

(2) The temperature produced by the decomposition process. (A low temperature retards decay of organic matter and vice-versa).

(3) The amount of water present in the material.

Some precautions to be taken

(1) The materials should be kept wet not soggy.

(2) The material should not be compact. It should be loose enough as to allow free air circulation.

(3) The pit should be protected from sun drying winds and rains.

(4) Flies should not be allowed, as far as possible, to lay their eggs in the pit as they may multiply and become a nuisance.

The heap method

The process of making compost in a heap is the same as that in the pit method. The idea is to place the vegetable material and manure in alternate layers separated by a thin soil or ash layer. The precautions taken are the same as in the pit method.

The heap should be made (120 cm x 120 cm x 150 cm) on level ground. Poles may be placed, in the ground in the four corners to support the heap. The sides of the heap should be well covered and protected with a layer of grass so that temperature

of the heap is maintained for microbes to remain active and carry on the decay of the composting material.

The following procedures should be adopted while making compost:

(1) Keep heap moist (damp) not soggy.

(2) Protect from sun, winds and rain and also from flies.

(3) After 5 days test for moisture content and temperature by removing stake. If it is too dry sprinkle water on the heap. If too wet remove stake and allow heap to be ventillated. If the stake is so hot that it cannot be grasped with the hand it is good. If it is cold decomposition is not occuring. Therefore turn heap again.

(4) After 14 days turn compost heap to hasten decay of material.

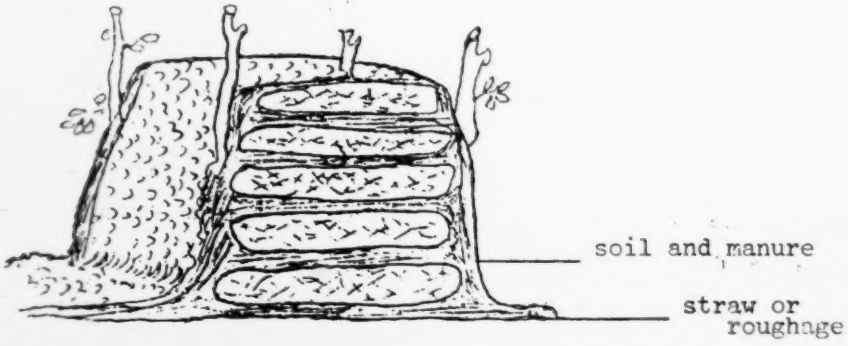
(5) If temperature is suitable turn a second time after 10 days otherwise after 14 days.

(6) Compost should be ready for use in 3 months.

(7) Break compost properly into small parts.

(8) Allow some more time for compost to mature.

A Compost Heap



Method of application of compost

1. Spread a layer of compost evenly on the surface of bed and mix it into the soil with a hoe. This is easier if the compost is relatively dry and crumbly.

This method is used for seed-bed preparation (Refer to page 95 Step II).

2. Put compost directly in pockets where the plant is to grow. This method is economical and is used for sowing or transplanting in holes or pockets. (Refer to page 95 Step III).

Compost is used as an alternative for manure.

CROP ROTATION

Each type of crop influences the soil in its own individual way. Different cropsremove different amounts of each kind of nutrients from the soil thus leaving it poorer in different degrees. They change the organic matter content as well as its acidity.

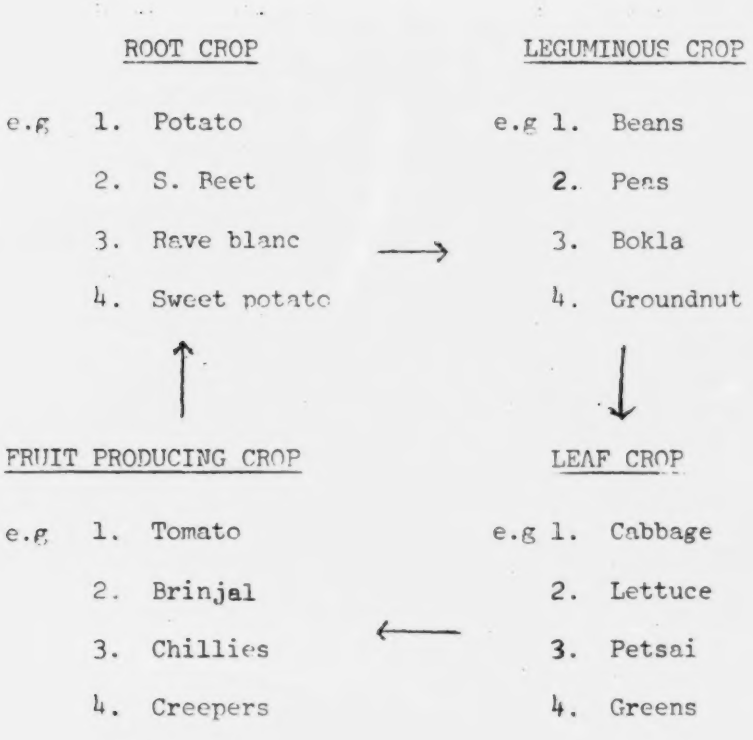
Plants also differ in their root characteristics. The deep roots of plants help to aerate the soil; to improve its drainage properties and to bring up minerals from the lower layers. Shallow rooted-plants on the other hand, bind the soil particles effectively against erosion. Leguminous (e.g beans) plants are known to enrich the soil with nitrogen while root crops (e.g manioc) in general are known to be heavy feeders which deplete the soil of its nutrient.

These observations explain the fact that when a crop is grown successively on the same field, yields tend to drop progressively. However, when unlike crops are grown successively such decline of yields is not observed. It has therefore become a practice to grow different crops successively on the same land to keep up the yield. This practice is known as Crop Rotation.

Crop rotation practices vary from one area to another depending upon the climate, the soil type, the prevalence of pests and diseases, the market demand and the farming

system. When growing vegetables it is important to rotate crops throughout the year. To allow you to plan a proper rotation sequence for your home garden, here is a model plan:

ROTATION SEQUENCE



CONTROL OF PESTS AND DISEASES

Crop production and for that matter gardening would have been very easy and more profitable if crops were not affected by pests and diseases. Every year agricultural production suffers great losses in terms of money and labour because of pests and diseases. A great deal of effort has been made and is still being made to eradicate both pests and diseases but success so far has been only partial. It is nearly impossible to control pests and diseases totally. However, attempts should be made to reduce damages caused by pests and diseases

so that better quality crops are produced and productivity is increased to feed the rapidly growing world population. For quite a long time now pest and disease control meant the application of chemicals on pests and disease causing organisms. It is well known fact that chemicals are very effective in the control of pests and diseases but an abuse in the use of chemicals is dangerous. The hazards, caused by pollution due to chemicals, to which man is exposed are arousing a growing concern among many nations.

As a result people in different parts of the world are seeking ways and means to ward off the dangers caused by pollution.

People who have the protection of the environment at heart are making a come-back to organic crop protection methods in a sincere attempt to reduce the extent of pollution caused by the use of chemical insecticides, fungicides and weedicides.

Pollution is most commonly caused in the following ways:

(1) The drift of chemicals in air during spraying.

(2) The contamination of water sources by the leaching of the residues of chemicals used in fields.

These chemicals present such dangers to man as:

(1) They indiscriminately kill birds, harmless insects and plant species which are useful to maintain the balance in nature.

(2) The residues that remain in vegetables, cereals and other crops after spraying are absorbed into the human body when these are consumed. These residues are injurious to health and are even fatal in the long run.

These hazards can be reduced or avoided by adopting cultural methods which decrease the dependence of the cultivator on chemicals.

Some conventional cultural practices which need be emphasised in crop production to achieve this are:

(1) Sow clean healthy seeds· transplant seedlings, and use planting materials such as cuttings or other plant parts which are disease-free.

(2) Eradicate infected crops.

(3) Practice garden sanitation by removing stalks, stubbles and plant debris.

(4) Practice deep ploughing. It disturbs and exposes the microbes which cause diseases to sunlight which kills them Deep ploughing also modifies conditions of temperature and humidity and makes them unsuitable for the growth of soil-born diseases and pests.

(5) Provide plenty manure which constantly supplies nutrients and promotes healthy growth.

(6) Modify the plant environment by practising the following:

(a) crop rotation
(b) mixed cropping

The terms 'pest' and 'disease' has severally been used here assuming that the user of this book knows what they mean. It may not, however, be superfluous to define a pest and a disease.

What is a Pest?

A pest is an organism (animal or plant) that causes harm to crops directly or indirectly. It interferes with growth, flowering and fruiting of crops. It is a nuisance and an enemy of crops. Some pests of vegetables are:

Thrips	Caterpillars
Mealy bugs	Stem borers
Scale insects	Beetles
White-fly	Cut worms

Aphids	Fruit flies
Mites	Leaf miners
Spiders	Nematodes (very small worms)

What is a Disease?

A disease can be defined as a deviation from normal growth. Usually it is accompanied by a disturbance of structure and function of the plant. It is injurious and affects a plant's parts or even threatens its life.

Diseases can be grouped into the following categories:

(1) Deficiency diseases i.e those caused by the deficiency of essential elements in the soil. They occur when certain essential elements are not available to plants.

(2) Fungal diseases: those caused by fungi.

(3) Bacterial diseases: those caused by bacteria.

(4) Viral diseases: those caused by viruses.

Fungal Diseases

Fungal diseases are caused by fungi. A fungus is a microscopic plant which lives on other plants (dead or living). When it lives on a living plant it is called a parasite. A parasite feeds on the tissues of the plant on which it lives to obtain its food. Thus it affects the plant and causes a disease.

Examples of fungal diseases are:

Powdery mildew
Downy mildew
Rust
Leaf spot
Molds

Bacterial Diseases

Bacterial diseases are caused by bacteria which are microscopic plants. They, like fungi cause diseases when they live in plants.

Examples of bacterial diseases are:

Rots
Wilting

Such diseases are encouraged by wet soil high atmospheric humidity and high temperature.

Viral Diseases

Viral diseases are caused by viruses. It is very difficult to say whether a virus is a living or non-living thing. Viruses are carried by insects such as aphids, white-flies and mealy-bugs. They can even be passed on by man from one affected plant to a healthy one.

Examples of viral diseases are:

Mosaic diseases
Leaf curl

Another group of important diseases are those caused by nematodes (very minute worms). Nematodes live in the soil and in water and multiply very rapidly when food is available. They damage vegetable roots. A plant affected by nematodes is sometimes recognised by the presence of nodules on its roots. Some vegetables commonly affected by nematodes are:

Brinjal
Chilly
Tomato

Alternative methods of crop production are being investigated, trialled and adopted so that the dependence on chemicals is lessened. These practices are summarized below and should be followed for successful organic gardening:

(1) Substitute chemical fertilizers by organic manures such as compost, farm yard manure poultry and goat manure.

(2) Practice mulching of crops

(3) Perform crop-rotation

(4) Practice mixed-cropping

(5) Grow companion plants

(6) Grow pest-repellant plants

(7) Encourage birds to visit the garden

(8) Grow resistant varieties.

Use of organic manures, mulching and crop rotation have already been covered. Therefore,we are going here to deal with those practices that have not been discussed earlier.

Mixed Cropping

It has been observed that a diversity of plants in nature, as well as in the garden. resist pest attacks better. A garden planted with only one crop attracts pests easily as the latter spread rapidly from one plant to the next in a row. They feed continuously and multiply rapidly. If there is a variety of crops the spread becomes difficult, the feeding activity is disturbed as the insects are selective and do not feed on all type of plants. A wide diversity of crops encourages a wider variety of insects. This allows the growth of predators and parasites of pests to multiply. In this way a natural control is ensured.

Companion Planting

This is based on the harmonious combination of healthy plants which occur in nature. Companion plants (those which are grown purposely in a combination with other plants) not only grow better but are free from pests and diseases. Weak plants are easily attacked by insects and are more susceptible to diseases.

Examples of companion plants are:

Bean and Swiss chard (epinard)
Leek and celery
Lettuce and Kholrabi
Brinjal and Marygold
Potato and Mustard
Beet and Onion

Pest Repellant Plants

A pest repellant plant is one which repels insects. Some repel most insects while others only a few specific ones. Such plants may have an offensive and repulsive smell.

The list below gives the name of some pests and the repellant plants which are offensive to them:

Ants	Spear mint
Aphids	Garlic, onion, leek, anise,
Cabbage moth	coriander, nasturtium, petunia
Nematodes	Mint, thyme, nasturtium, celery
Leaf-hopper	Marygold, dahlia, calendula
Hare	Petunia, Geranium
	Garlic, onion, thyme, leek

Encouraging birds to visit the garden

Birds usually feed on insects and worms. Certain birds can be of great help if allowed to visit the garden. If they are shy or scared they can be attracted to come in by throwing away bread crumbs and other left-over food from the kitchen to them.

If certain birds become troublesome by eating freshly-sown or germinated seeds and seedlings make a mesh with thread over the seed-bed to protect the young plants.

For the efficient control of pests it is essential that the cultivator is able to recognise them. Some of the commonly found pests are described below:

Grass hoppers	Like the locust about 2 - 5 cm long. Green or yellowish green in colour. Strongly built flattened slender body. Active in behaviour. Have a pair of long hind-legs for jumping. Chew stems and leaves, often damage seedlings too.
Thrips	Very small, pale coloured. Usually found in clusters at the base of onion, garlic and leek leaves.
Mealy-bugs	White, soft, slow moving bugs, feed by sucking sap of plants.
Scale insects	Oval or round. Light or dark coloured, found usually on undersurface of leaves and on stem of woody plants. Feed by sucking.
Whiteflies	Small. white similar to moths. Feed by sucking sap. May transmit diseases.
Aphids	Green, black or grey in colour. Occur in dense clusters on the undersurface of leaves. Feed by sucking sap. Carry viruses. Winged ones hold wings vertically when at rest.
Caterpillars & Stemborers	Caterpillars vary in size and colour. Feed by eating leaves and fruits. May move by looping.
Cut worms	Grey-brown caterpillars. Feed just below the soil level. Eat seedlings at the base at night.

Beetles	Black, brown or striped. Have a pair of strong, thick scaly wings and another pair of soft transparent ones. Feed on leaves, stems roots. Damage seedlings.
Weevils	Similar to beetles in appearance; larvae feed inside pods and stems.
Fruit-flies	Very small. Damage fruits. The maggots feed inside fruits.
Mites	Smallest pests. Found in colonies on leaves. Colony enlarges rapidly. Damage leaves causing them to curl
Leaf miners	Very small larva. Live in between the upper and lower surface of leaves. Feed on the leaf tissues. Not easy to destroy. Common on most vegetables
Nematodes	Live on the roots of beans, peas, chilly, brinjal. Forms swelling on affected parts. Takes up food from plant roots causing stunted growth. Very small thread like worms.

CULTURAL PRACTICES

Here under are the Cultural Practices of some vegetables for the kitchen garden.

BEAN (Haricot)

Botanical Name: Phaseolus Vulgaris

Food value and uses

It is a rich source of protein. It also contains calcium. Immature pods and seeds are eaten as vegetables. Widely used in salads and pickles.

Soil type

All types of soil are suitable for bean cultivation. Bean tolerant to wide range of soil conditions. Does well if rainfall is moderate. Soil should be well drained.

Sowing time

All year round. Best yield is obtained for crop grown in April and May.

Vegetative cycle: 2 months

Varieties

Canadian wonder
Long Tom, Victory, Local red
'mangetout'
Bush blue lake, Processor, Contender, Noorinbee

Seed rate

240 gm/10 m^2 .
Seeds should not be more than 1 - 1½ year old.
Use only healthy and unaffected seeds.

Soil Preparation and Cultivation

Soil should be tilled to a depth of 25 cm and well manured. Seed can be sown either in double rows or in pockets. In single rows, furrows should be 15 cm broad and 12.5 cm deep spacing should be 15 - 22.5 cm in between plants in a row. In double rows, furrows should be 15 cm broad and 12.5 cm deep. Interval in between rows should be 37.5 cm and 75 cm in between pair of rows.

In pockets, place 3 seeds per pocket. Pockets should be at 30 cm interval. Seeds should be sown at about 2.5 cm deep. To ensure a regular supply of fresh bean, sow seeds every 20 days. Plants should be watered at least once a day or on alternate days till harvest. 15 days after

germination remove the weeds manually or using a hoe. Earth up the soil around base of the plants.

Harvest

At 40 days harvest of the fresh pods. Harvesting should be done every third or fourth day. Harvest lasts between 20 - 30 days.

Yield

7 - 14 kg fresh green pods for 10 m^2
1 - 2 kg bean pulse for 10 m^2

Pest and Disease Control

Bean fly: Spray every 7 days from 3rd day after germination.
Decis 2.5 E.C.
½ ml/litre of water.

Pod borer: Lannate 25%
2 gm/litre of water

Red spider: Morocide 50%
1½ gm/litre of water

Angular leaf spot: Dithane M 45
2 gm/litre of water every 7 days.

Anthracnose: Benlate 50%
½ gm/litre of water at floweing time at
7 days interval.

BRINJAL (Egg plant)
Botanical Name: Solanum melongena

Food value and uses

The fruit is cooked in a variety of ways. It may be boiled, fried or stuffed. It may even be fried in batter. It contains calcium, iron and ascorbic acid in little amount.

Soil type

A light and well drained soil is desirable. Soil should be deeply tilled and richly supplied with compost or manure.

Sowing time

Can be grown throughout the year in warm regions. However, sowing is done mostly in August - September period. Seedlings are transplanted from September to October.

Vegetative cycle: 12 months

Varieties

Cipaye (long and slender)
Farci and Rosita (globular)

Seed rate

15 gm/3 m^2

Cultivation

Sow in furrows on seed-beds which have been properly worked and well manured. Furrows should be 40 cm apart. Seeds should be placed at the rate of 12 - 15 seeds for 30 cm of furrow. Seedlings are ready at $1\frac{1}{2}$ - 2 months after sowing. They are usually transplanted at 3-4 leaf stage.

Seedlings are transplanted in pockets 20 x 20 cm and 15 cm deep. The distance from plant to plant should be 90 cm. Place seedling at 2.5 - 3 cm deep in pocket. Fill the packet with soil and water copiously. Remove weeds at every two weeks interval. Earthing up should follow hoeing and weeding.

Watering

Once seedlings are established they should be watered at least once daily. During drought watering should be more frequent. It should be noted that brinjal does not tolerate excessive water in the soil.

Harvest

Harvest may start at around 3 months after transplanting. Pick up fruits every 2 - 3 days when they are tender. They are generally glossy in appearance.

Disease and Pest Control

Powdery mildew	Thiovit or Thiocide 80% 3 gm/litre of water
Bacterial wilt	Grow resistant varieties
Nematodes	Destroy affected plants Grow resistant varieties Practice crop rotation
Phomopsis blight	Dithane M45 2 gm/litre of water Uproot affected plants and burn them.
Red spider	1.5 gm/litres of water Morocide 50%

CHILLY

Botanical Name: Capsicum annum

Uses

Chillies have a pungent smell and are hot to taste. They are eaten raw in salads and are cooked in various ways. They are used for seasoning and are often pickled. They are the ingredients of curry powder together with other spices.

Soil type

Light and well drained soil which is rich in humus and slightly acidic is suitable for chilly cultivation.

Sowing time

In sub-humid regions - from May to October
In other regions at the beginning of summer.

Varieties

Cipaye

Petit piment

Vegetative cycle: Cipaye: 6 months
Petit piment : 12 months

See rate: 1 - 2 gm/40 m^2

Soil preparation and cultivation

Soil should be well tilled and friable.

(i) Sow seeds in drills on seed-beds which have been richly supplied with manure or composts. Seed should be placed at the rate of 12 - 15 seeds for each 30 cm furrows. Cover up seeds with a thin layer of soil. Water the bed.

After 2 months the seedlings will be at the 3 - 4 leaf stage. Transplant one seedling per pocket which has been well provided with manure. The pockets should be 20 cm x 20 cm and 15 cm deep. Spacing should be for Cipaye 30 cm x 30 cm and for Petit Piment 60 cm x 60 cm.

(ii) Seedling can be planted directly in pockets on double rows. The distance between rows should be 5 cm and between pair of rows 7.5 cm. The distance between the plants within the row should be 30 cm. Remove weeds at every two weeks interval. After weeding earthing up should be done.

Watering

After transplanting, water the seedlings frequently till they are established. Once established water at least once daily. Chilly plant does not tolerate excessive water in soil. Flowering may be adversely affected by heavy rain.

Harvest

Fruits are ready for harvest about 2 months after seedlings are transplanted. Usually yield is 1 lb/m^2 . Yields are higher in summer.

Pest and Disease Control

Mites	Spray Monocide 50% 1½ gm/litre of water every 7 days
Leaf miner	Decis 2.5 E.C ½ ml'litre of water every 7 days.
Mildew	Benlate 50% ½ gm/litre of water
Damping off	Spray Ridomil M258 2 gm/litre of water Spray every 10 - 15 days
Bacterial wilt	Practice crop rotation

CARROTS

Botanical Name: Daucus Carota

Food Value and uses

Carrot is consumed as a vegetable both raw and cooked. It is eaten raw as salad and the juice is also consumed as a drink. It is a rich source of carotene, a precursor of Vitamin A. It also contains sugar, calcium and ascorbic acid.

Soil type

A light soil rich in organic matter and slightly acidic is suitable for carrot. It should be deeply tilled and well drained.

Sowing period: Carrot may be sown from January to September.

Varieties

Chanteney type: Western Queen. Cape market

Nantaise type: Scarlet Nantes

Seed Rate: 1 gm for 37.5 cm of furrow when sown in drills

8 gm/10 m^2 for broadcasting on beds

Soil preparation and cultivation

Soil should be thoroughly tilled to a depth of 30 cm . The soil should be loose and friable. Sow seeds on seed beds 1 m wide. The beds should have been well manured with well rotten compost which is properly mixed with the soil. Mix seed with fine and dry sand and broadcast over the seed-bed. Then spread a thin layer of soil to cover the seeds. Press soil lightly with a plank.

When the seedlings reach 7.5 cm high, thinning should be done leaving a space about 5 cm between plants to prevent over crowding. Weeding also should be done as soon as the seeds germinate.

Watering

Watering should be abundant till seeds sprout up. Then water at least once daily. Thinning should always be followed by thorough watering.

Harvest

Handpulling 3 - 4 months after sowing. The yield is 2 kg/m^2

Pest and disease control

Ants	Spray Basudin 60% or Gusathion 20% 1½ ml/litre of water
Cut worm	Volaton 0.5% Apply in band placement around plant base.

LEEK

Botanical Name: Allium porrum

Uses

Leek can be a good substitute for onion when supply is short. The whole plant is eaten. It is used in the preparation of soup and in seasoning dishes.

Soil type

Deeply cultivated. well drained soil which is rich in organic matter.

Sowing Time: March to September.

Vegetative cycle: 6 months

Varieties

The Italian Giant is very common. Other imported varieties are also grown.

Seed Rate: 10 gm/m^2
60 bulbils/4 m^2

Soil preparation and cultivation

(i) Broadcast seeds on seed-beds as for carrots to produce seedlings. Seeds should be sown at the rate of 10 gm/sq.m The seeds should then be covered by a thin layer of soil. Press the soil lightly using a plank, then water seedbed. Small plants should be 1 cm thick at 2 - 2½ months. Before transplanting cut the leaf tops by half and reduce the length of the roots.

(ii) Plantation by Bulbils

The bulbils obtained from the inflorescence of leek plants are detached to be planted separately. When these attain 1 cm thick in diameter they are planted on well manured nursery beds. The bulbils are usually planted at a distance of 2.5 cm from one another.

Transplantation

Bulbils are transplanted in furrows 30 cm broad and 25 cm deep. The distance between the centre of a pair of furrows should be 60 cm. Fill the furrows with a mixture of soil; manure and fertilize up to a height of 15 cm. Place the bulbils, in the furrows, 25 cm apart and 5 cm deep. The

distance between two rows in the furrow should be 25 cm.

Weeding and earthing up should be done regularly and gradually to produce long and white leeks.

Watering

Water plants regularly throughout vegetative growth.

Harvest and Yield

Harvest should start 4 months after transplanting. The yield is around 4 - 5 kg/m^2

Pest and disease control

Thrips	Spray Tamaron 60% 1 ml/litre of water every 15 days
Leaf miner	Decis 2.5 E.C ½ ml/litre of water every 7 days
Mites	Spray Monocide 50% 1½ gm/litre of water every 7 days

THYME

Botanical Name: Thymus vulgaris

Uses

Fresh leaves are used as seasoning in foodstuffs. Its oil is used in the manufacture of perfume and toothpaste. It is an antiseptic.

Soil type

Grows in the humid and super humid regions of the island and also in dry regions under irrigated conditions. Soil should be light and moderately fertile.

Sowing time: Any time provided irrigation is available.

Vegetative cycle: can stay up to 3 years.

Soil preparation and cultivation

Soil should be well tilled and mixed with manure or compost. Obtain cutting from mature plants. Cuttings should be placed in the soil so that only $^{2}/_{3}$ of it remains in the soil for proper root development. The distance from plant to plant should be 25 cm within rows and 20 cm between rows.

Weeding should be done regularly otherwise weeds will smother the plants.

Harvest: throughout the year.

Pest and disease control

Uproot diseased plants and discard them if affected as new plants can be easily grown again.

NEW ZEALAND SPINACH

Botanical Name: Tetragonia expansia (Epinard)

Uses and food value

Fresh leaves are cooked as vegetables. Good source of Vitamin A and minerals such as calcium and iron.

Soil type

It can tolerate most type of soils.

Sowing time: Sown during winter months from May to beginning of September.

Vegetative cycle: 3 - 4 months

Varieties: Local

Seed rate: 50 gm/10 m^2

Soil preparation and cultivation

Seeds which have been soaked in water for 24 hours are sown in well cultivated seed-bed. Bed should be 1 m wide. The bed should be abundantly manured. 1 or 2 seeds are placed in small pockets on the bed at a distance of 20 cm x 40 cm.

Weeding should be done soon after seedlings appear.

Harvest

Cut the top parts of the tender shoots at every 3 weeks interval for 3 months. Seeds should be sown every 2 months to obtain a regular supply of fresh spinach.

Pest and disease control

No specific control measures are required. Caterpillar can be a nuisance. Spray Decis 2.5 E.C, ½ ml/litre of water every 10 - 15 days.

CORIANDER

Botanical Name: Coriandrum sativum

Uses

Seeds are used widely in curry-powder, pickling, sausages and confectionery. It is also used in flavouring spirit and gin.

The leaf is used to make chutneys, sauce and soup. The plant has medicinal properties also.

Soil type

All types of soil preferably well drained and containing lot of organic matter.

Sowing time: Throughout the year. Does well during winter months.

Vegetative cycle: 3 - 4 months

Seed Rate: 20 gm/4 m^2

Before sowing, seeds should be lightly crushed to facilitate germination.

Soil preparation and cultivation

Seeds are sown in seedbeds which have been thoroughly tilled and manured. Seeds are broadcast and covered with a fine layer of soil.

Seeds can also be sown in furrows 30 cm apart. Thinning should be done to avoid over-crowding and weeding as soon as weeds show up. Seedlings should be watered daily.

Harvest and Yield: 1 - 2 kg of seeds/4 m^2

Pest and Disease control: Usually not affected by pests and diseases

MINT

Botanical Name: Minta piperata

Uses

Used in cooking as condiment to flavour dishes. Chutneys are made from the leaves. It is appreciated because of its medicinal properties. It is used in confectionery and liqueurs. Oils are also extracted from mint.

Soil type

All types of soil are suitable but it prefers loamy soils which are rich in organic matter and are easily drained.

Planting time: Throughout the year.

Cultivation

Once planted by stem cuttings, the plant grows for 2 - 3 years. It should be planted again from cuttings after the third year. Usually roots develop at the nodes of the stem or stolen. Stems cuttings are planted in furrows 30 cm apart. They should be placed 2/3 of their length under the soil. Control roots if they spread too much.

Weeding should be done regularly.

Harvest: Shoots are harvested when they are well developed.

Pests and diseases control

Usually not affected by pests and diseases but if they are uproot plants and discard.

COMPOSITION OF FRUITS AND VEGETABLES COMMONLY CONSUMED IN MAURITIUS

(Per 100g)

COMMON NAME	Protein (g)	Fats (g)	Carbohydrates (g)	Ca (mg)	P (mg)	Fe (mg)	Vit C (mg)	Vit A (I.U)
A. Cereals								
Maize (mature) (grain yellow variety)	9.5	4.4	69	20	280	3.0	0	200
B. Starchy roots, tubers etc.								
Bread fruit (fruit à pain)	1.5	0.3	25	28	34	2.0	31	16
Taro (arouille)	1.8	0.1	24	51	88	1.2	8	t
Sweet potato (patate douce)	1.6	0.2	28	33	38	2.0	37	125
Cassava (manioc)	1.2	8.3	32	8	38	1.3	20	100
Potato (pomme de terre)	1.7	0.1	19	13	51	1.1	21	40

COMMON NAME	Protein (g)	Fats (g)	Carbohydrates (g)	Ca (mg)	P (mg)	Fe (mg)	Vit C (mg)	Vit A (I.U)
C. Nuts and seeds								
Groundnut (pistache)	23	45	23	49	409	3.8	t	..
Pigeonpea (ambrevade)	19	1.3	66	161	285	15	-	90
Coconut (noix de coco)	3.6	39	13.8	21	103	2.5	2	42
Soya (soja)	34	18	34	183	541	6.1	-	90
Butterbean (gros pois)	21	1.4	61	116	387	5.0	t	..
Kidney bean (haricot rouge)	22	1.5	61	120	323	8.2	t	17
Sweetpea (petit pois)	22	1.1	62	90	382	18	t	25
Broad bean (bokla)	26	1.3	59	140	301	6.8	16	210
D. Vegetables								
Beetroot (betterave)	1.9	0.1	10.5	24	43	0.8	3	20
Kale (chou-rave)	1.2	0.1	7.0	50	40	0.6	30	330
Cabbage	2.0	0.1	5.4	35	61	1.2	96	25
Turnip (navet)	1.0	t	4.7	38	42	0.5	75	16
Pumpkin (giraumon)	0.5	t	9.3	27	18	-	12	..
Squash (patisson)	1.0	0.1	5.5	25	32	1.4	8	6000
Carrot (carrotte)	0.9	0.1	9.6	35	38	0.7	8	9150
Okra (lalo)	2.1	0.2	8.2	84	90	1.2	47	310

COMMON NAME	Protein (g)	Fats (g)	Carbohydrates (g)	Ca (mg)	P (mg)	Fe (mg)	Vit C (mg)	Vit A (I.U)
Calabash (callebasse)	0.5	0.1	5.2	44	34	2.4	10	42
Ridged gourd (pipengaille)	0.6	0.1	1.0	13	40	1.0	4	
Bitter gourd (margoze)	1.2	0.2	5.8	13	32	0.2	227	-
Common bean (haricot)	2.5	0.2	7.9	43	48	1.4	27	1250
Chayote (chou-chou)	1.2	0.2	4.4	18	15	0.9	10	
Tomato (tomate)	1.0	0.2	4.8	10	24	0.6	26	750
Eggplant (bringelle)	1.0	0.2	7.7	14	26	1.3	9	60
Snake gourd (natole)	0.5	t	3.6	20	20	0.2	-	-
Cowpea (voëme)	5.0	0.3	8.0	300	60	6.0	60	-
E. Leaf Vegetables								
Amarantus (brède malabar)	4.6	0.2	8.3	410	103	9.0	64	9527
Indian Spinach (brède gandolle)	1.8	0.3	3.7	138	69	0	39	
Chinese cabbage (brède de chine) (brède pet-sai)	1.3	0.2	2.3	35	39	0.5	30	30
Indian kale (brède songe)	2.4	0.6	5.7	98	49	2.0	11	3000
Pumpkin (brède giraumon)	4.0	0.2	4.4	477	136	0.8	80	6000

COMMON NAME	Protein (g)	Fats (g)	Carbohydrates (g)	Ca (mg)	P (mg)	Fe (mg)	Vit C (mg)	Vit A (I.U)
Horseadish (brède mourougue)	8.2	0.6	14.7	571	149	11.4	182	19866
Watercress (brède cresson)	7.9	0.2	3.4	64	46	1.1	50	1600
Chayote (brède chou-chou)	3.3	-	4.7+	40	90	5.0	18	7600
Nightshade (brède martin)	4.3	0.8	5.7	442	75	1.0	20	6100
Spinach (brède épinard)	2.1	0.2	5.3	61	46	1.7	46	-

FRUITS

Fruits are important in the diet for the health of the family. They provide both vitamins and minerals. It is therefore, important to have a few fruit trees growing at home.

Which fruit to grow?

When choosing a fruit tree the following points should be carefully considered:

(i) the space available
(ii) the climate of the area
(iii) the fruiting period
(iv) the nutritive value of the fruit (esp. the vitamin content).

Space

Certain fruit trees need much space to grow properly while others grows well in limited space. In table 1, the major fruit trees are grouped according to the amount of space they need.

Table 1: Spacing of the major fruit trees

Large space 9m x 9m	Medium space 6m x 6m	Little space 3m x 3m
Letchis	Orange	Pawpaw
Longane	Mandarine	Pineapple
Mango	Peach	Banana
Avocado	Guava	

When planting fruit trees it is important to observe the recommended planting distance. Planting at closer intervals leads to over-crowding and hence poor yield.

Climate

It is important to consider the climatic conditions prevailing in the area when deciding on the type of fruits to grow. Most fruit trees will not yield fruits if they are grown on the central plateau.

Table 2 will help you to identify the fruits that will grow properly in your area.

Table 2· Climatic adaptation of local fruits

	Superhumid Region ex. Midlands, Union park, Curepipe, Belle Rive, N. France, B. Cheri. Dagotière	Humid A region ex. Vacoas, St. Pierre, Rivière des Anguilles, etc..	Humid B region ex. Réduit, Rivière du Rempart, Surinam Pamplemousses, etc..	Sub-humid region ex. B.Bassin P. Louis, Triolet, Goodlands etc..
Avocat	+	+	++	+
Atte			+	++
Banane	++	++	++	+
Bibasse	++	++	++	+
Bigarade	++	++	+	+
Bilimbi long		+	++	++
Bilimbi Rond		+	+	++
Carambole		+	+	++
Cerise	++	++	++	+
Citron	+	++	++	++
Corosol			+	++
Coco			+	++
Coeur de boeuf		+	+	++
Fraise	+	++	++	
Fruit à pain			+	++
Fruit de cythère			+	++
Goyave	++	++	++	++
Grenade			+	++
Grenadine	++	++	++	++
Jacque	+	+	++	++
Jamalac	++	++	++	+
Letchi		++	++	++
Limon (lime)		+	+	++
Longane		++	++	++
Mandarine	++	++	++	++
Mangue			+	++
Masson			+	++
Orange		++	++	++
Pêche	++	++	++	+
Vigne		+	+	++

Note: ++ = grow very well
+ = grow well

Source: Extension Service Division Ministry of Agr, Fisheries & Natural Resources

Fruiting Period

Some fruit trees yield fruits only during one or two months of the year (e.g Letchis, mango) while others yield fruits almost all the year round, (e.g pawpaw, banana). Fruits which yield during longer period provide regular supply of fresh fruits and are more beneficial to the family. Hence, fruits like pawpaw, guava, banana, pineapple, passion fruit, lemons should have their place in your garden especially if you have limited space.

Nutritive Value

The main reason for growing fruit trees is to secure a regular supply of fresh fruits which will improve the family diet in terms of vitamins and minerals. Hence, when selecting fruit trees for your garden it is important also to consider the nutritive value of the fruits.

To help you to choose intelligently the fruits you may grow in your garden, the vitamin content of the main fruits grown in Mauritius is provided in Table 3.

Table 3: The Vitamin content of some local fruits

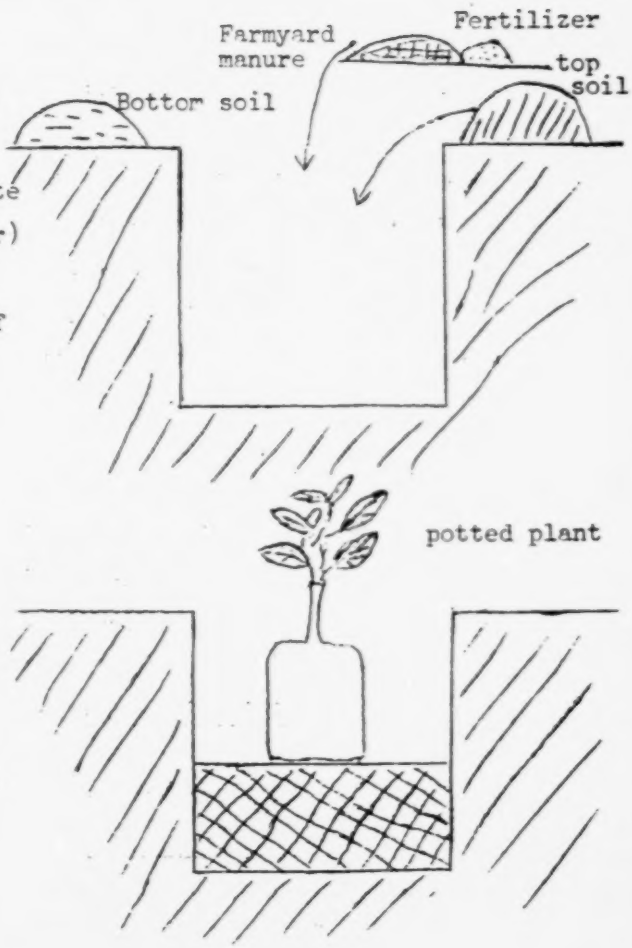
	Nutritive Value of Fruits	
	mg/100 gm	I.U
	VIT C	VIT A
Chinese guava (red)	500	300
Chinese guava (yellow)	480	300
Guava	200	200
Longane	480	200
Jujuba	300	
Pawpaw	80	1000
Mango	30	600
Avocado	15	200
Sweet melon	30	500
Water melon	5	30
Letchi	50	-

	mg/100 gm VIT C	I.U VIT A
Citron	18	-
Bigarade	40	
Orange (imported)	45	-
Lemon	40	-
Grape fruit	30	-
Pineapple	30	100
Banana	10	100
Apple (imported)	5	20

Note: I.U Stands for International Unit

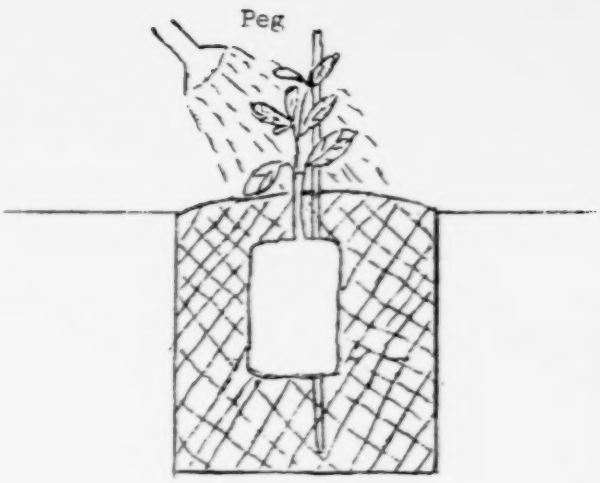
How to plant a fruit tree?

Dig a hole of size 60 cm long 60 cm wide and 60 cm deep. While digging the hole separate the top soil (darker in colour) from the bottom soil. Mix the top soil with 3 baskets of well-rotten farmyard manure and 500 gms of the compound fertiliser 13:13:20:2. Reject the bottom soil.



Partly fill the hole with this mixture so that the plant can be placed at the proper height as shown in the diagram. After removing, the plastic bag, place young plant at the centre of the hole and fill the hole with the rest of the soil mixture.

Press the soil around the plant firmly and place a strong peg deep in the soil near the plant to serve as support. Water the plant copiously.



Care of fruit trees

The young plant should be watered regularly daily if necessary. It should be inspected at weekly interval for symptoms of pest or disease attack. In case of any such attack consult your district Extension Officer for advice.

A regular application of fertilisers is indispensable for a fruit tree to produce fruits properly. Fertilisers may be applied in the organic form (e.g Farmyard manure, compost etc) or artificial fertilisers (e.g 13:13:20:2). It is, however, preferable to apply both together. Table 4 gives an indication of the amount of manure and fertilisers that should be applied to a fruit tree.

The amount as you will notice, increases with the age of the plant up to the fifth year. This amount of fertilisers should be split into three applications (at 4 months interval).

Table 4: Fertilisation of fruit trees

Age of plant	Manure per year	Fertiliser 13:13:20:2 per plant
At planting	30 kg	500 gm
1st year	50 kg	800 gm
2nd year	60 kg	1,300 gm
3rd year	70 kg	1,800 gm
4th year	80 kg	2,300 gm
5th year	90 kg	2,800 gm

GROWING BANANA

Season : All year round but preferably during the wet summer months

Locality : All the regions of the island

Soil : Adapts well to all soil types except water-logged soils.

Varieties : The recommended variety is the "Naine" or Dwarf Cavendish. A variety which grows low and is less susceptible to cyclones. It is also free from 'Panama disease". The "Ollier" variety may also be planted. The ollier variety is a taller plant.

Planting material : Propagation is done through suckers. Suckers come out regularly around the mother plant. Only suckers which are $2\frac{1}{2}$ - 3 months old should be selected for planting. They should be around 1 m high.

Sucker treatment : Before planting, dip sucket in a solution containing 80 gm of Benlate 50
100 cc of Basudin 60
for $\frac{1}{2}$ drum of water.

Planting : Plant in holes of size 60 cm x 60 cm x 60 cm. The holes should be spaced at 2 m by 2 m. proceed as for planting of a fruit tree (page 127).

Cultural practices : (i) De-sucking. As the young plant grows new suckers will appear. Too many suckers will affect the yield of the plant. Hence most suckers should be removed. Only one sucker should be allowed to grow for each period of 3 - 4 months.

(ii) Fertiliser application - Apply 250 gm of 13:13:20:2 per plant at 3 - 4 months interval.

Harvest : The mother plant yields its fruits about 12 months after planting. The bunch is harvested when mature but green. As the suckers grow they will successively bear fruits at intervals of 4 - 5 months giving 2 - 3 harvests per year. After 4 - 5 years the yield of the plants goes down. It is therefore recommended to renew the plantation after 5 years.

Pests : An important pest which attacks the banana plant is the "banana weevil". It may be controlled by drenching the soil around the roots with a solution of BASUDIN 60. The solution should contain 1 tablespoonful (10 ml) of Basudin 60 for one watering can of water (2 gallons).

GROWING PAWPAW

Season : All year round.

Locality : Sub-humid and humid regions.

Soil : Light and well-drained soil.

Varieties : Solo (round), wilcox (oblong).

Seeds and seed treatment : Select large fruits and allow to ripen. Remove seeds, wash and allow to dry. Select the large seeds for planting. Before storing seeds treat them with THIRAM 75% at the rate of $\frac{1}{4}$ gm/100 gm of seeds.

Sowing : Sow seeds on a seed-bed in drills 2 cm deep and spaced 30 cm apart. The seeds should be placed at interval of 5 cm along the drills. Cover the seeds with a thin layer of soil Alternatively sowing may

be done in a wooden box 15 cm deep. Fill the box with a mixture of 7 parts top soil
3 parts Farmyard manure
1 part sand
Compound fertiliser 13:13:20:2 (at the rate of 1 gm/6 cm^2 of soil surface.

Germination : 1 week after sowing

Transplanting : 2 - 3 weeks after sowing, transplant seedlings in plastic bag 15 cm high and 12 cm diameter containing soil-manure sand mixture (7:3:1). Keep potted seedlings in shade for 2 weeks and water them daily. After 2 weeks, place plants in the sun and water them daily. The seedlings are ready to be planted when they reach a height of 50 cm.

Planting : Dig hole of size 45 cm x 45 cm x 45 cm. The holes should be spaced at 3m x 3m. Proceed as for planting of a fruit tree (page 127).

Fertilisers (i) At planting - 2 baskets of Farmyard manure
½ basket of sand
500 gm of 13:13:20:2

(ii) Add 200 gm of 13:13:20:2 per plant at 3 months interval for the rest of the life of the plant.

Cultural practices : Water the plant regularly. The soil around the base of the plant should be weeded whenever necessary.

Harvest : About 10 months after planting the first fruits will be ready for harvest.

Production : A plant will yield around 30 - 50 fruits per year. After 4 - 5 years fruit production drops. It is advisable then to replace the plant.

Uses of some vegetables and fruits in food production

Vegetables fruits	Uses	Sweet dishes
Beans	Fricassé or sauté, curry, boiled, accompaniment to main dishes, salad, pickles (mixed vegetables)	
Carrot	Served as raw salad, stews, purée. Boiled, soup, pickles, with beetroot, eggs etc..	Halwa (Carrot fudge)
Epinard	Gratin, soup, soufflé, cooked with lentils ..... fricassé.	
Brinjals	Fricassé, chutneys, curry, cooked with pulses, stuffed brinjals, fritters, pickles, cooked with meat fish.	
Cabbage	Salad, fricassé, soup, curry. pickles,	
Banana	Green banana: curry, fricassé, chips	Ripe - Fruit - With mixed fruit salad - Banana Bread (Bake) - Banana Milk shake - In desserts (tart)
Papaya	Green pawpaw Curry, fricassé, Gratin, pickles.	Ripe - Fruit dessert -(Compote), Jam - Crystallisé
Guava	Green: pickles	Ripe - Fruit - Salad - Jam, Jellies

Vegetables Fruits	Uses	Sweet dishes
Lettuce	Salad	
Brède Malbar Touffé		
Cotomili	Green leaves - Chutneys, for garnishing, sauces for flavour, briani curries.	
Thyme	Add flavour to Pulses, vegetables and meat dishes	
Mint	Chutneys sauces and as flavour in some curries and briani	

CROP CALENDAR

Crop	Planting time	Harvesting Time
Garlic	March - May	August - November
Bean	Year round	Year round
Groundnut	September - December	January - May
Beet	May - September	July- December
Brinjal	October - December	Year round
Carrot	January - September	Year round
Cabbage	March - August	June - November
Cauliflower	March - September	June - December
Vines	September - February	January - March
Maize	Year round	Year round
Onion	March - June	June - September
Squash	October - March	October - April
Chinese cabbage	March - September	May - November
Pea	April - September	July - December
Leek	April - September	July - December
Radish	March - September	April - October
Tomato	Year round	Year round.